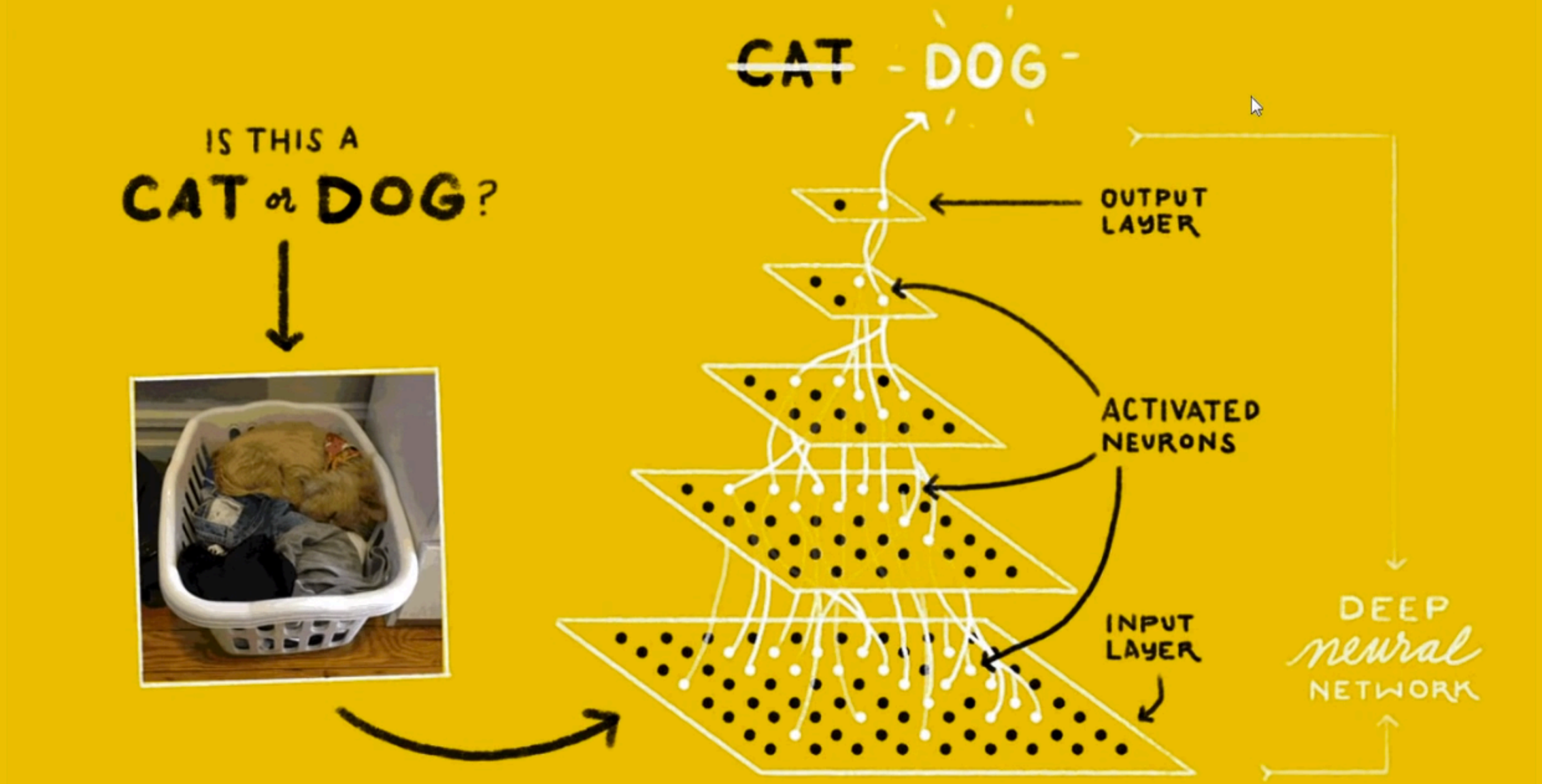
Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow

Kanit “Ham” Wongsuphasawat **@kanitw**
University of Washington

Daniel Smilkov, James Wexler, Jimbo Wilson,
Dandelion Mané, Doug Fritz, Dilip Krishnan,
Fernanda B. Viégas, Martin Wattenberg
Google Research



From "Large-Scale Deep Learning with TensorFlow," Jeff Dean – https://youtu.be/vzoe2G5g-w4

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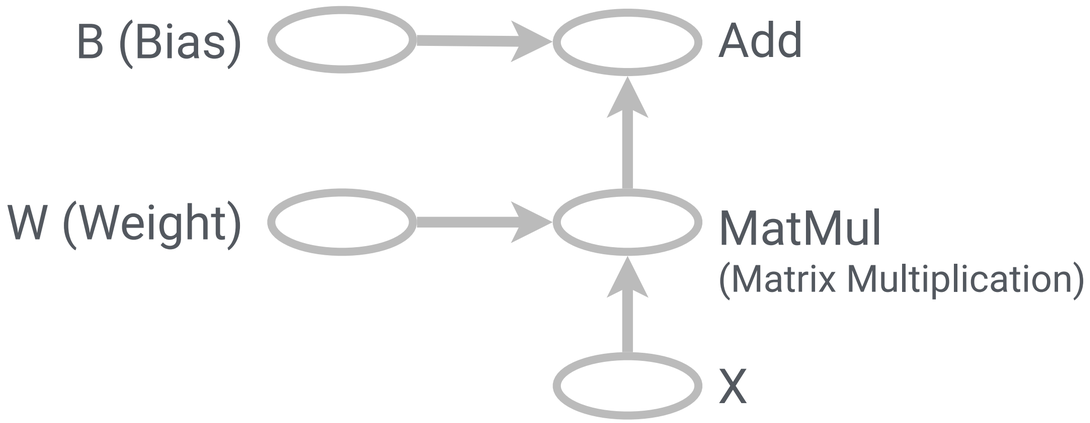
TensorFlow: Dataflow Graphs for Machine Learning

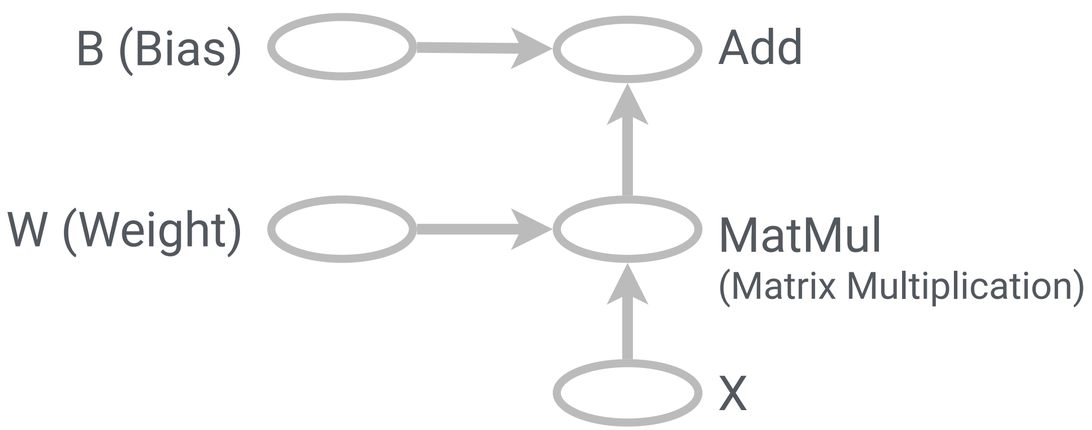
Using dataflow graphs to represent computation.



Dataflow graph for a linear model ($WX+B$)

TensorFlow: Dataflow Graphs for Machine Learning

Using dataflow graphs to represent computation.



Dataflow graph for a linear model ($WX+B$)

nodes = operations

e.g., mathematical functions,
constants (initializing values),
summaries (logging data)

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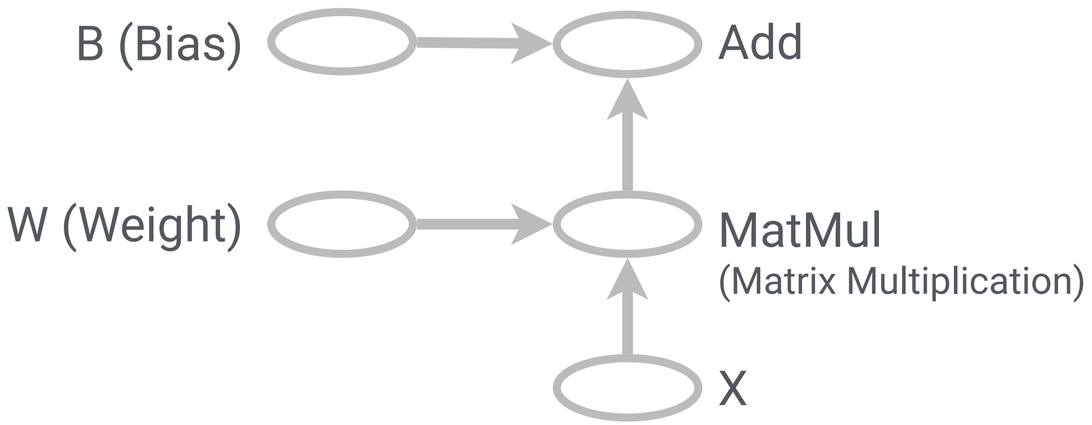


Dataflow graph for a linear model ($WX+B$)

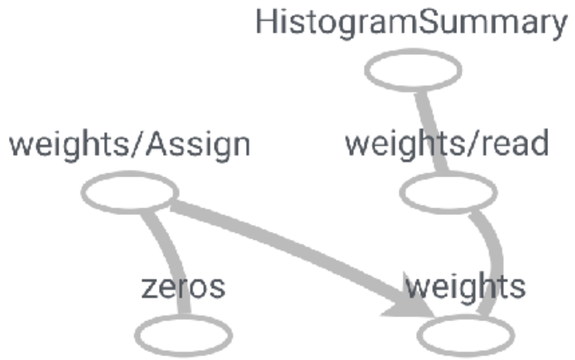
nodes = operations

e.g., mathematical functions,
constants (initializing values),
summaries (logging data)

edges = data

multi-dimensional array (**tensors**)


```
zeros = tf.zeros([784, 10])
W = tf.Variable(zeros, name='weights')
tf.histogram_summary('weights', W)
```



High-level Program

Low-level Dataflow Graph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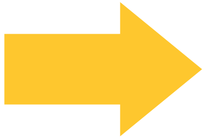

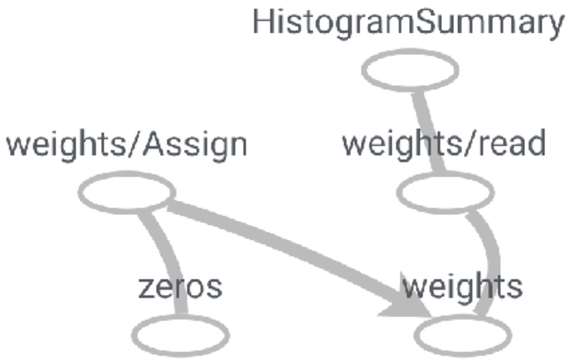

High-level Program

Low-level Dataflow Graph

Easy to implement models that supports distributed computation, various kinds of devices, and variety of learning algorithms.


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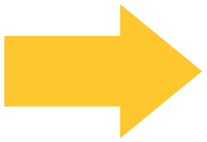
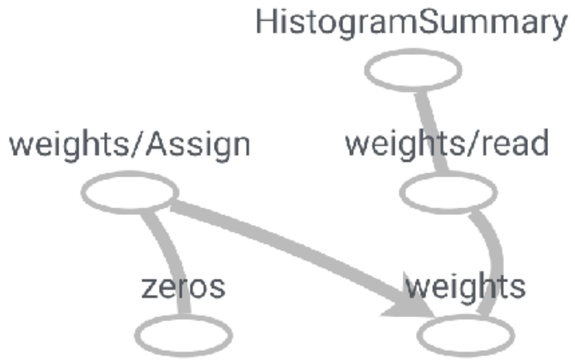




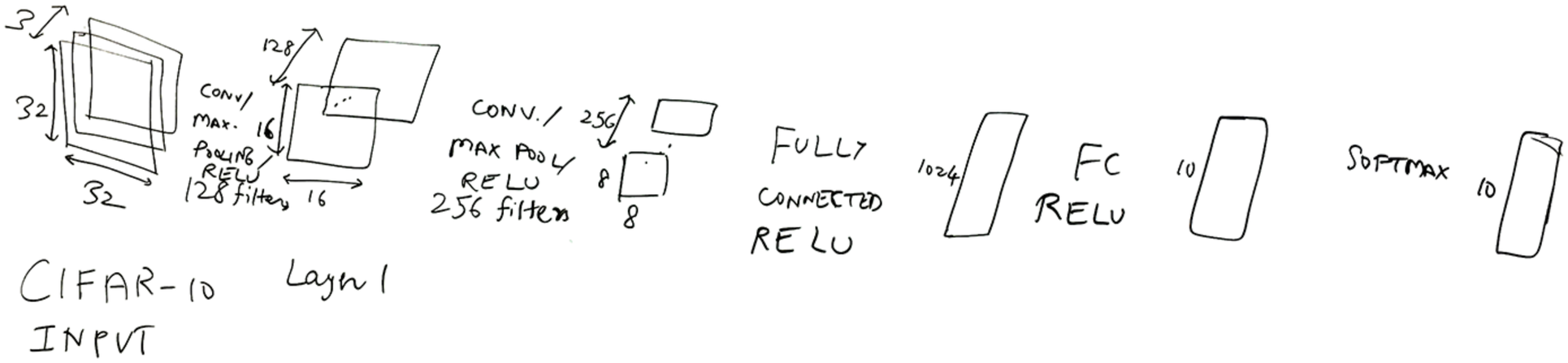
High-level Program

Low-level Dataflow Graph

Easy to implement models that supports distributed computation, various kinds of devices, and variety of learning algorithms.

Understanding the graph structure from the code can be challenging!

Model developers use diagrams to understand and share *high-level* structures of their models.



Typical hand-drawn diagram of a network by a researcher at Google

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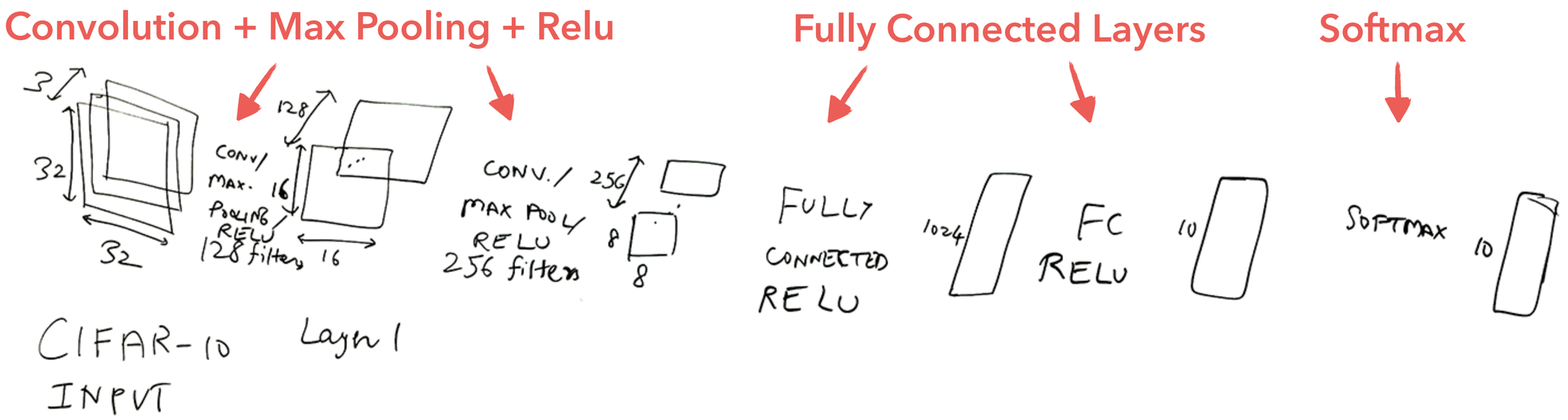

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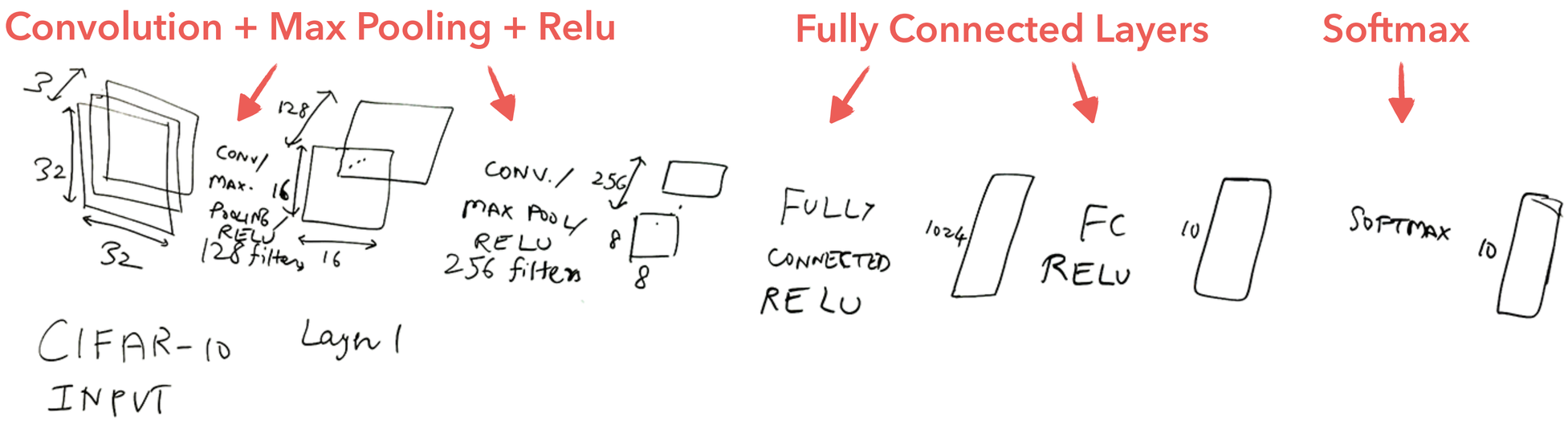
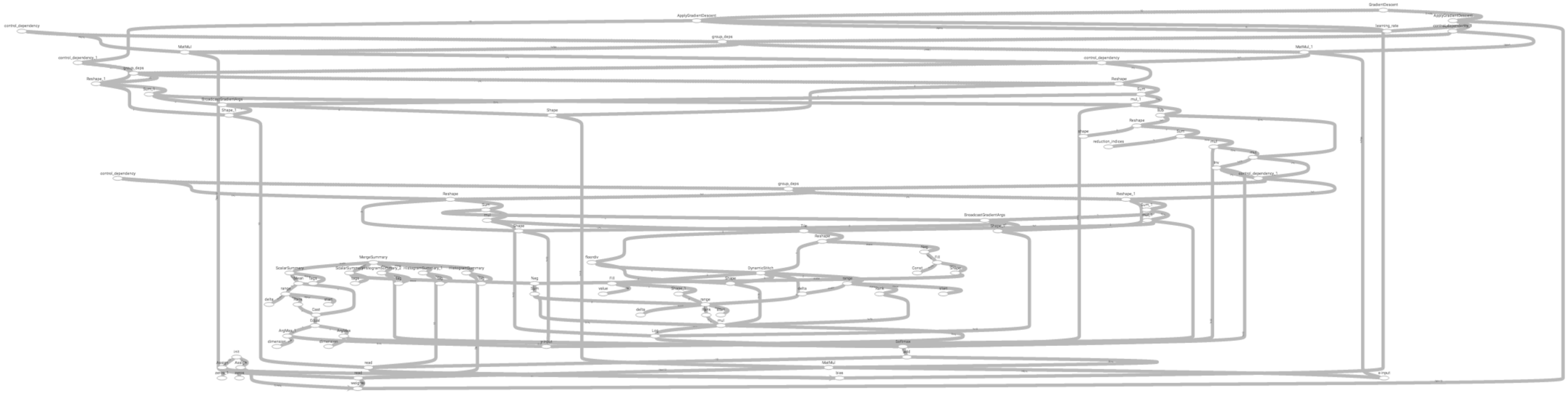


Typical hand-drawn diagram of a network by a researcher at Google

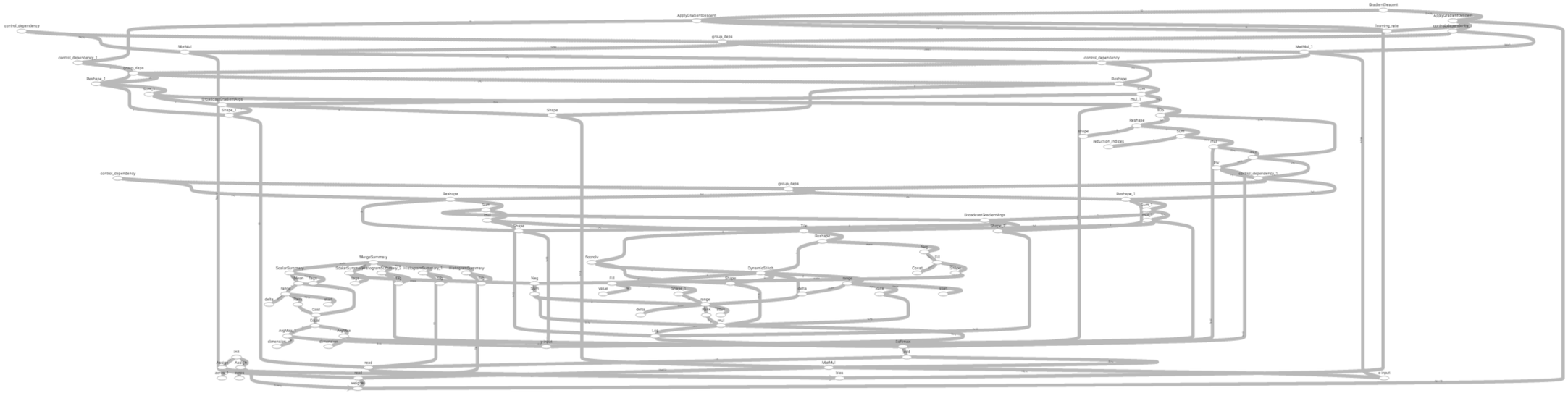
Automatic tool to visualize the model structure?

Standard graph drawing tools produce cluttered layouts



Sugiyama-style flow layout of a linear model (WX+B)

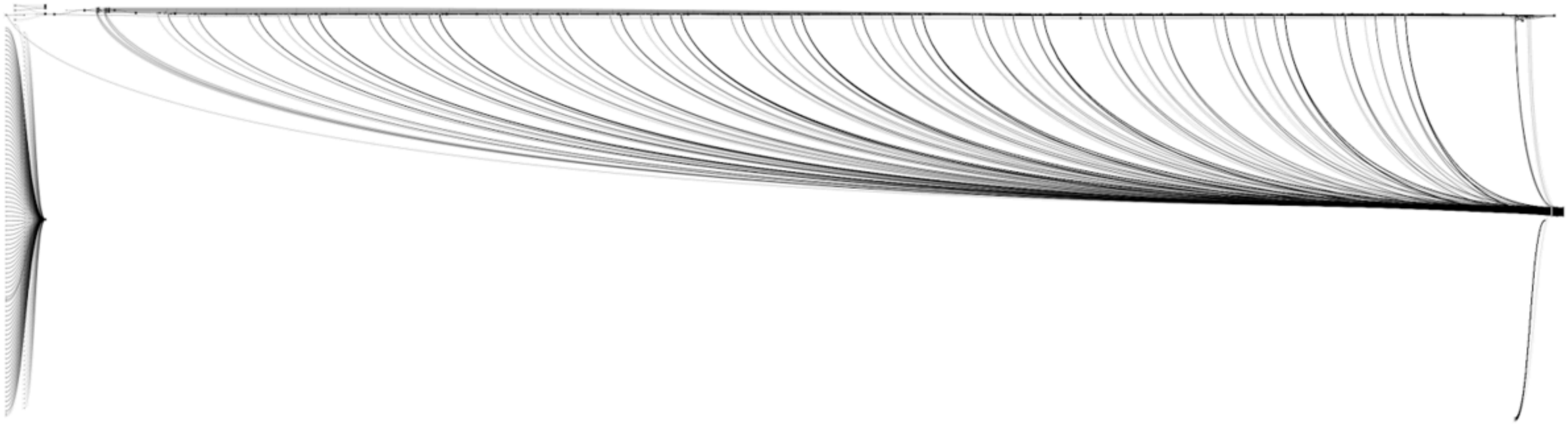
Standard graph drawing tools produce cluttered layouts



Sugiyama-style flow layout of a linear model (WX+B)

TensorFlow's "Hello World"!

Standard graph drawing tools produce cluttered layouts



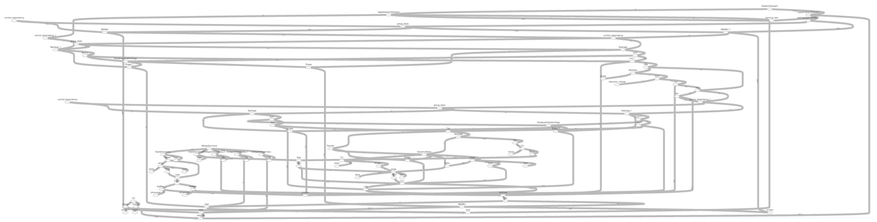
Sugiyama-style flow layout of a convolution network

TensorFlow

Graph Visualizer

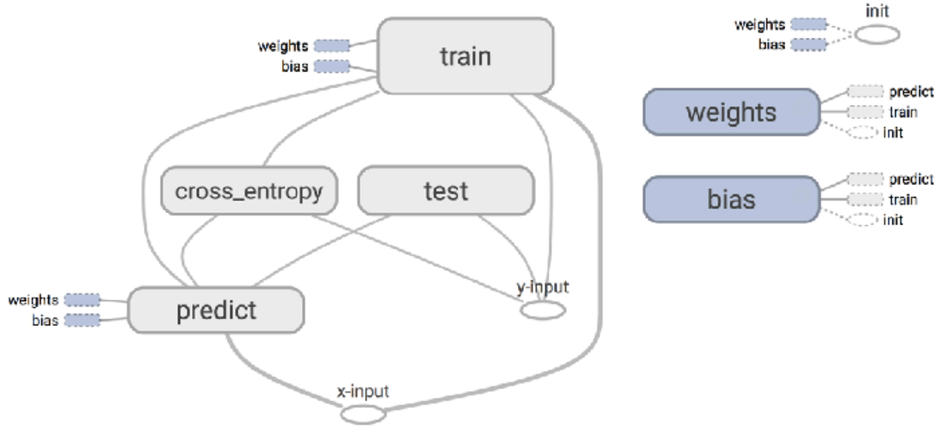
Help TensorFlow developers understand and inspect the structure of their models

TensorFlow
Graph Visualizer



Low-level
Dataflow Graph

Graph
Transformations



High-level
Interactive Diagram

TensorFlow Graph Visualizer

Visualizing Dataflow Graphs
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TensorFlow Graph Visualizer

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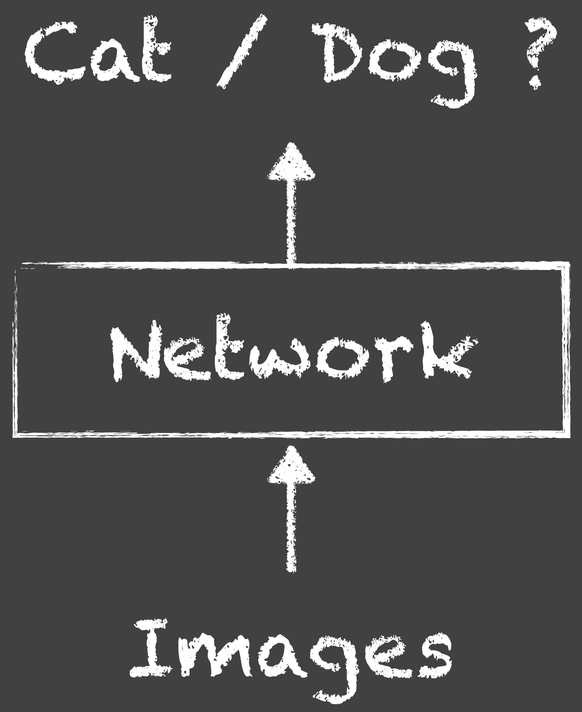
Introduction

Explore a Convolutional Network

Transformation Strategies

Usage Pattern & Feedback



A dataflow for
training a convolution network
for image classification

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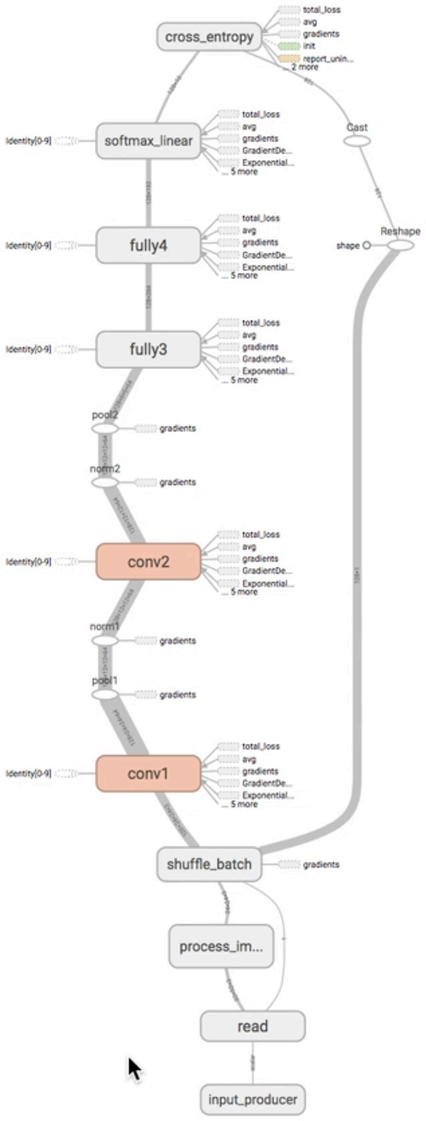
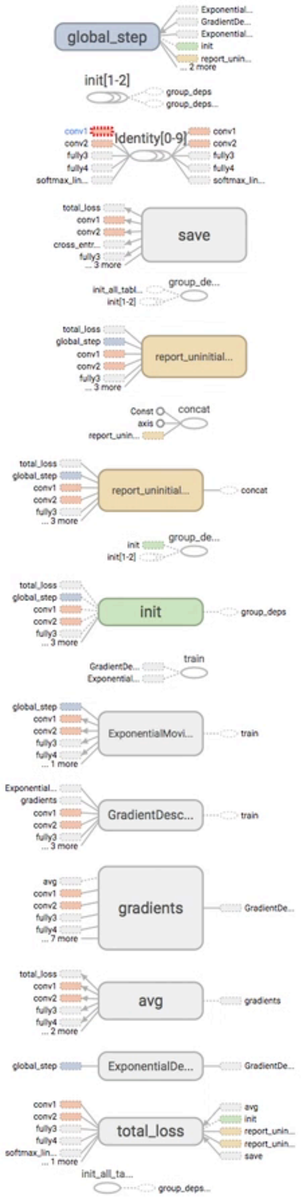
Namespace*
OpNode
Constant
Summary
Dataflow edge
Control dependency edge
Reference edge

Main Graph



Auxiliary Nodes



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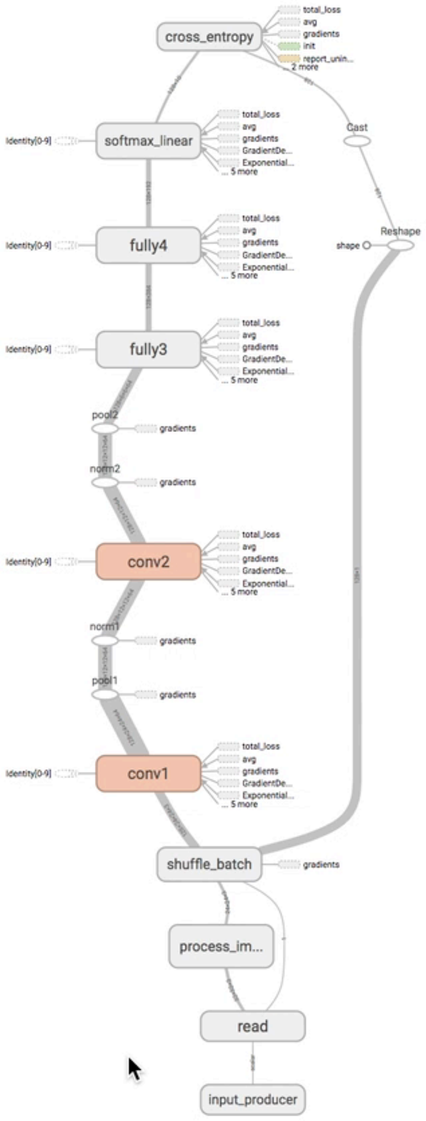

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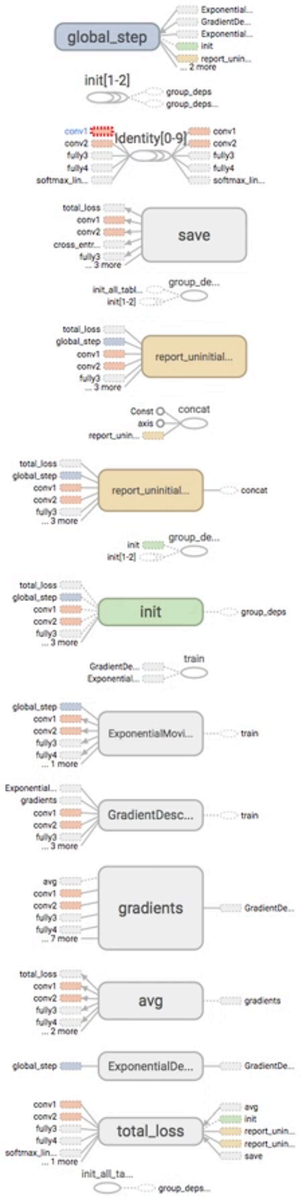
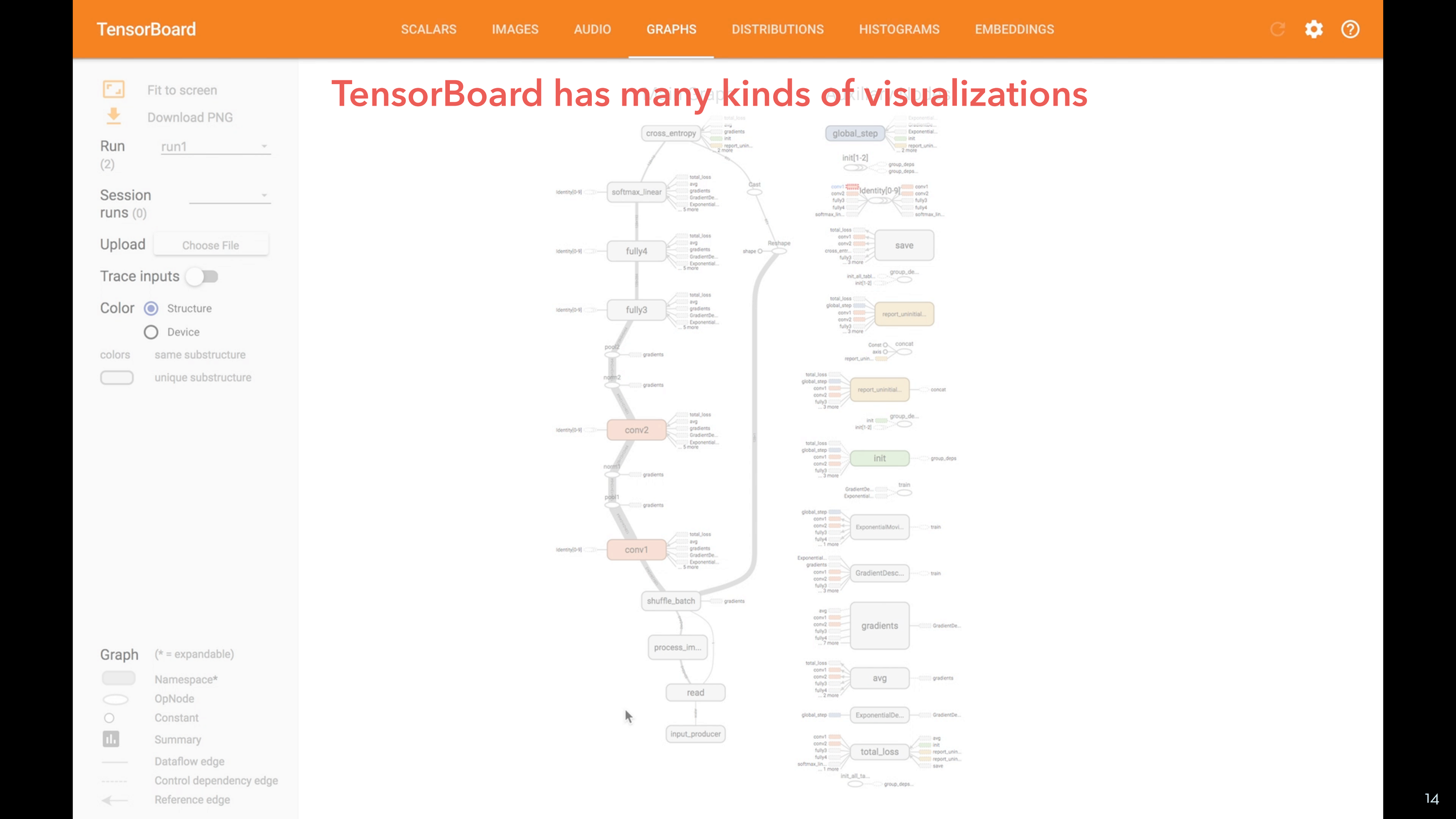


TensorBoard has many kinds of visualizations



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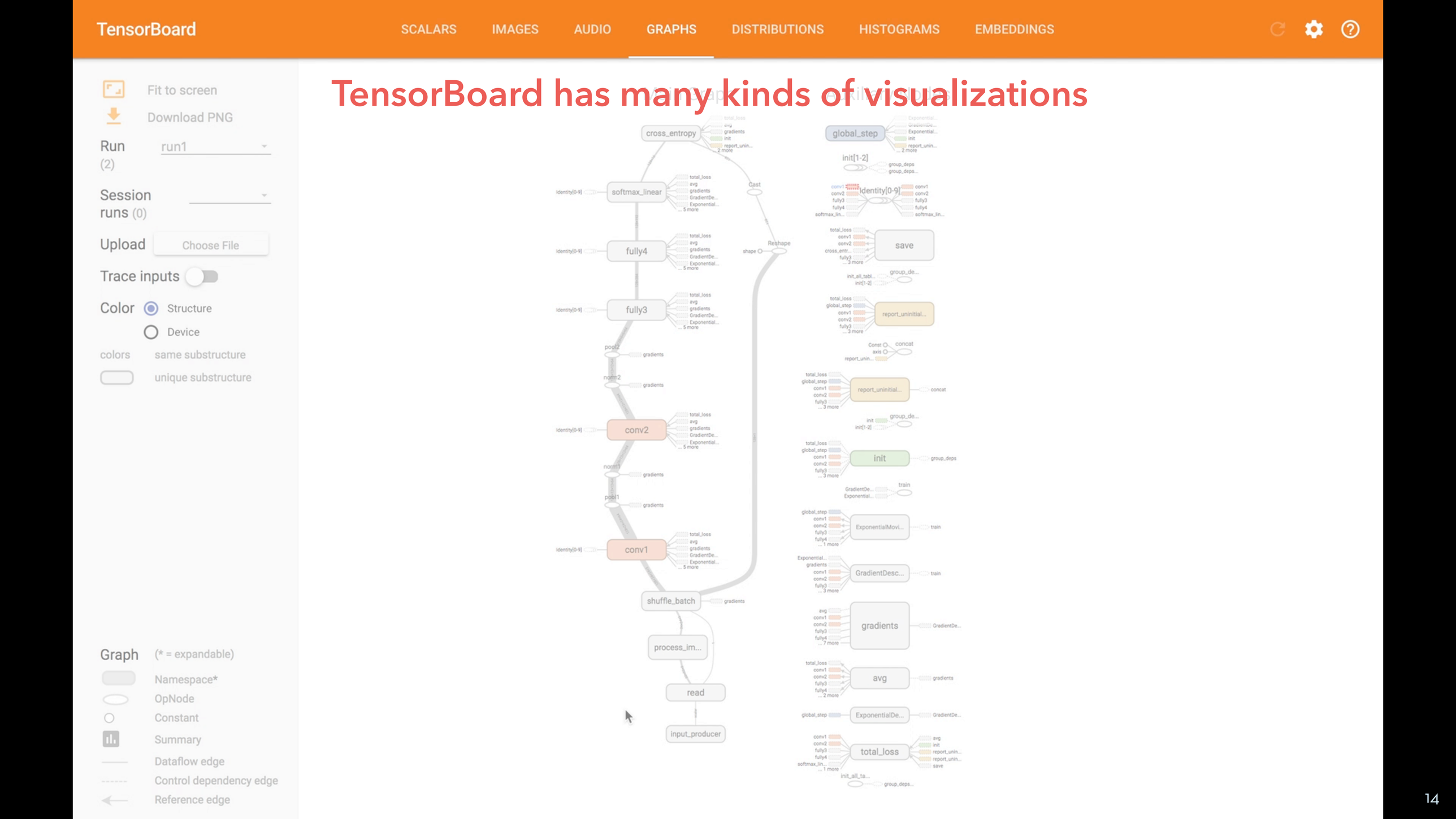

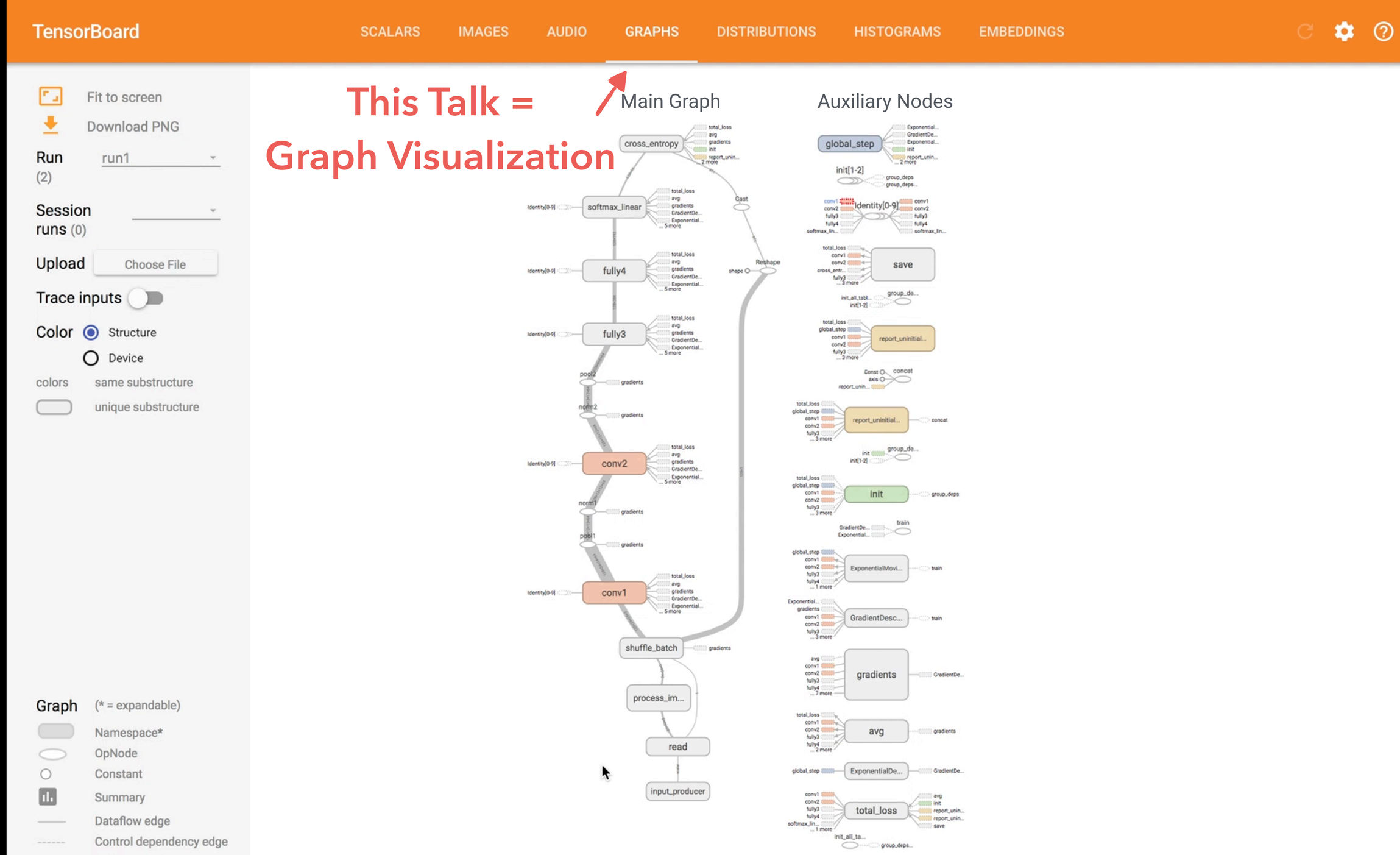
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softmax_linear
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fully3
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conv1
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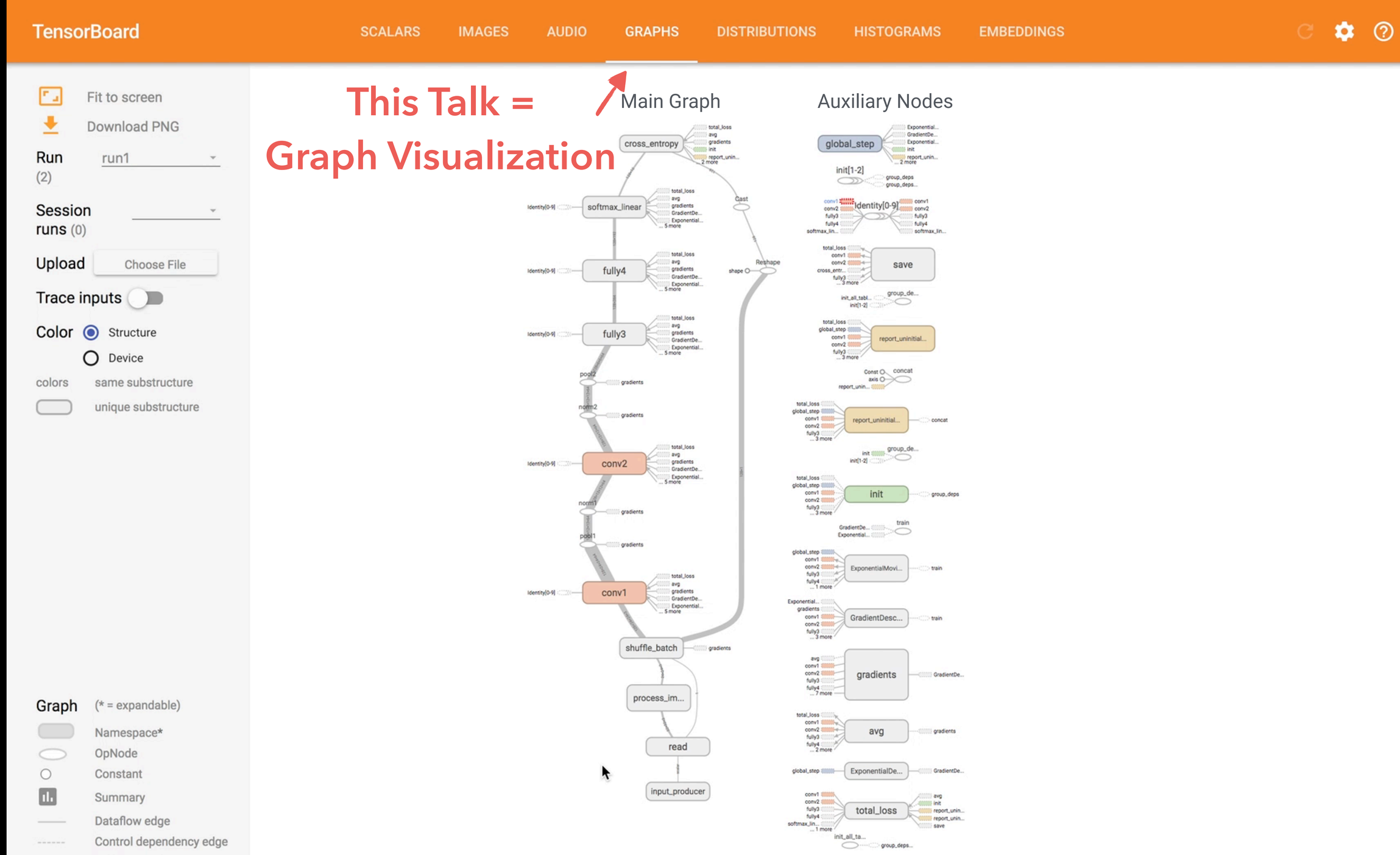
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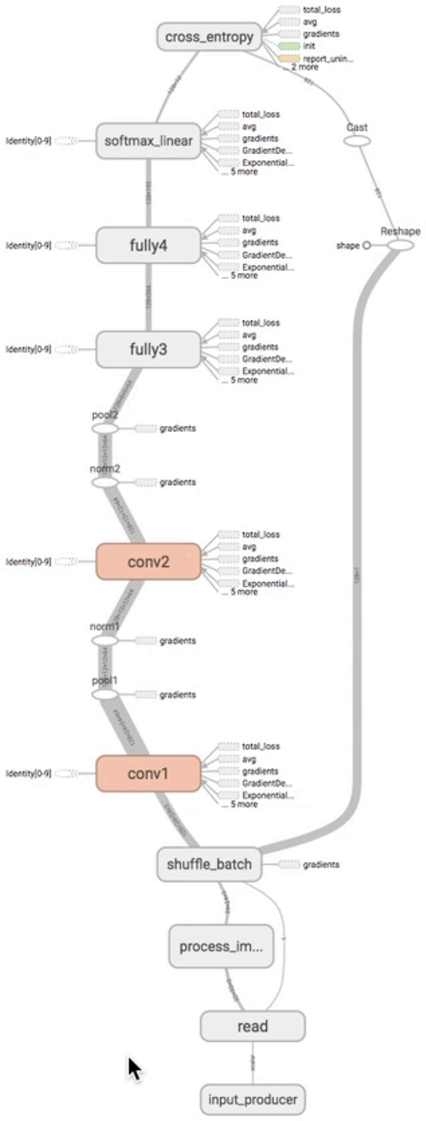

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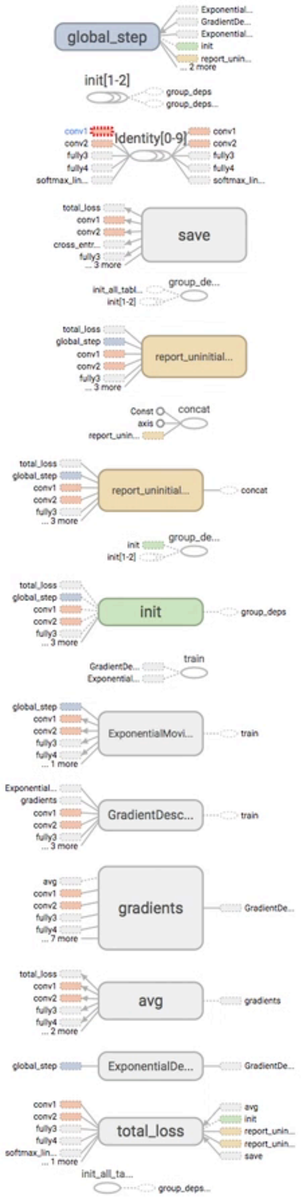

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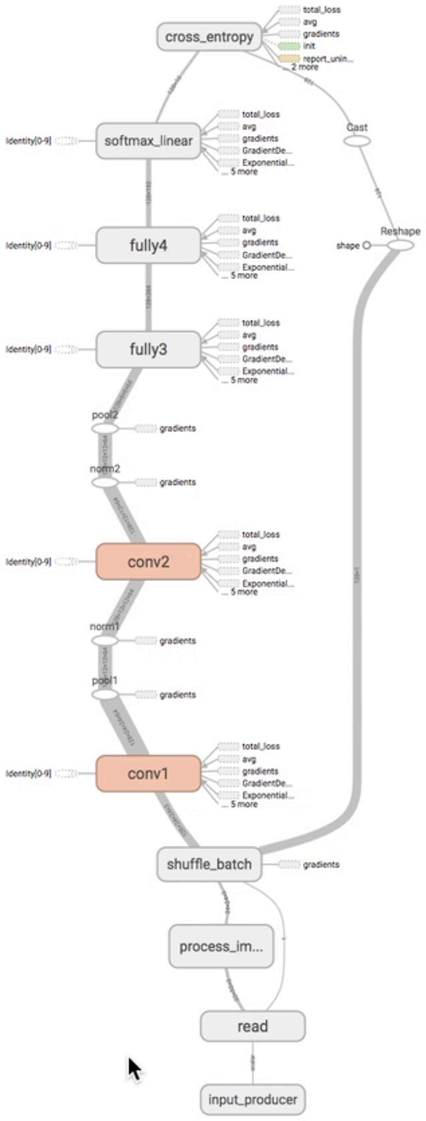

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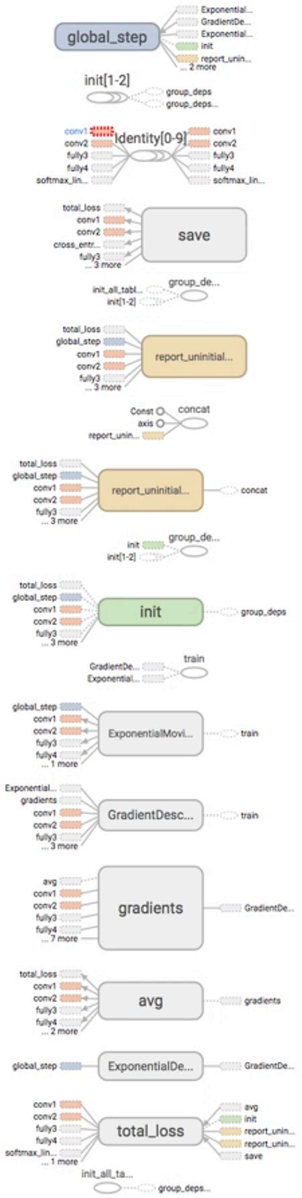

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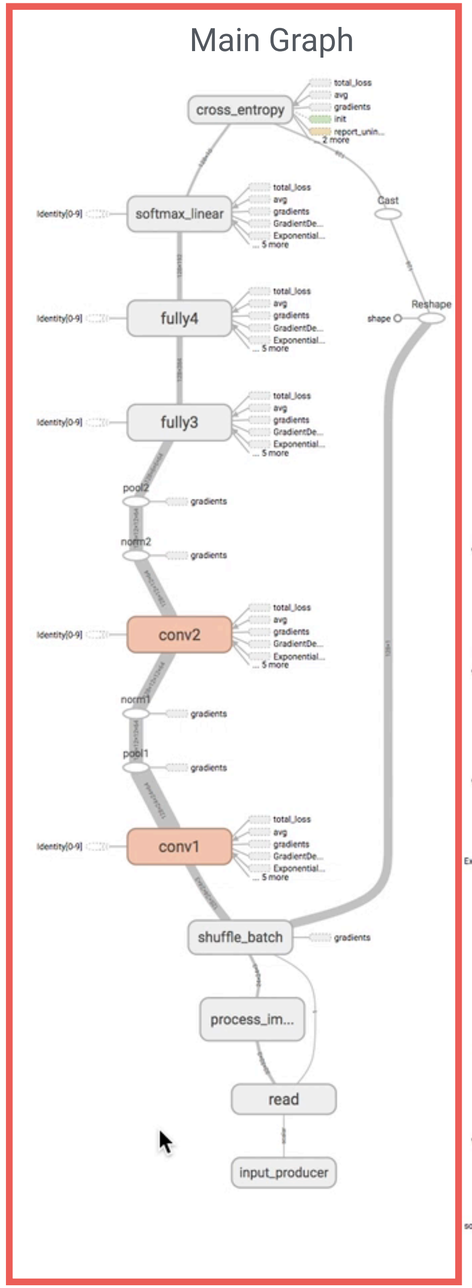
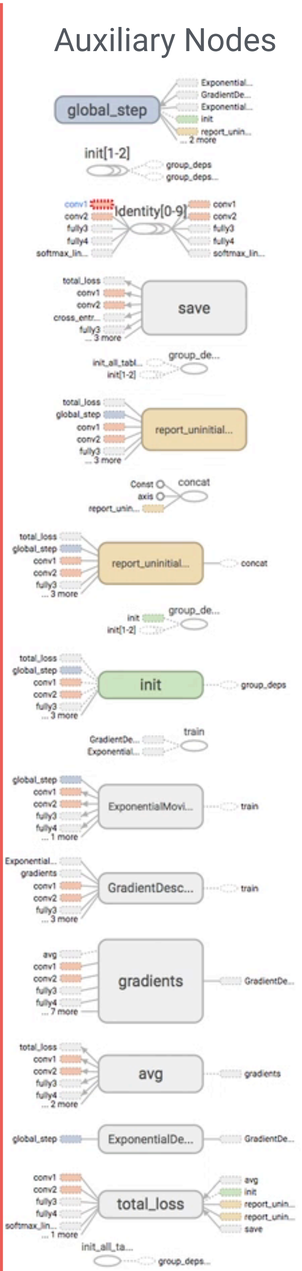
Main Graph

Core computation flow





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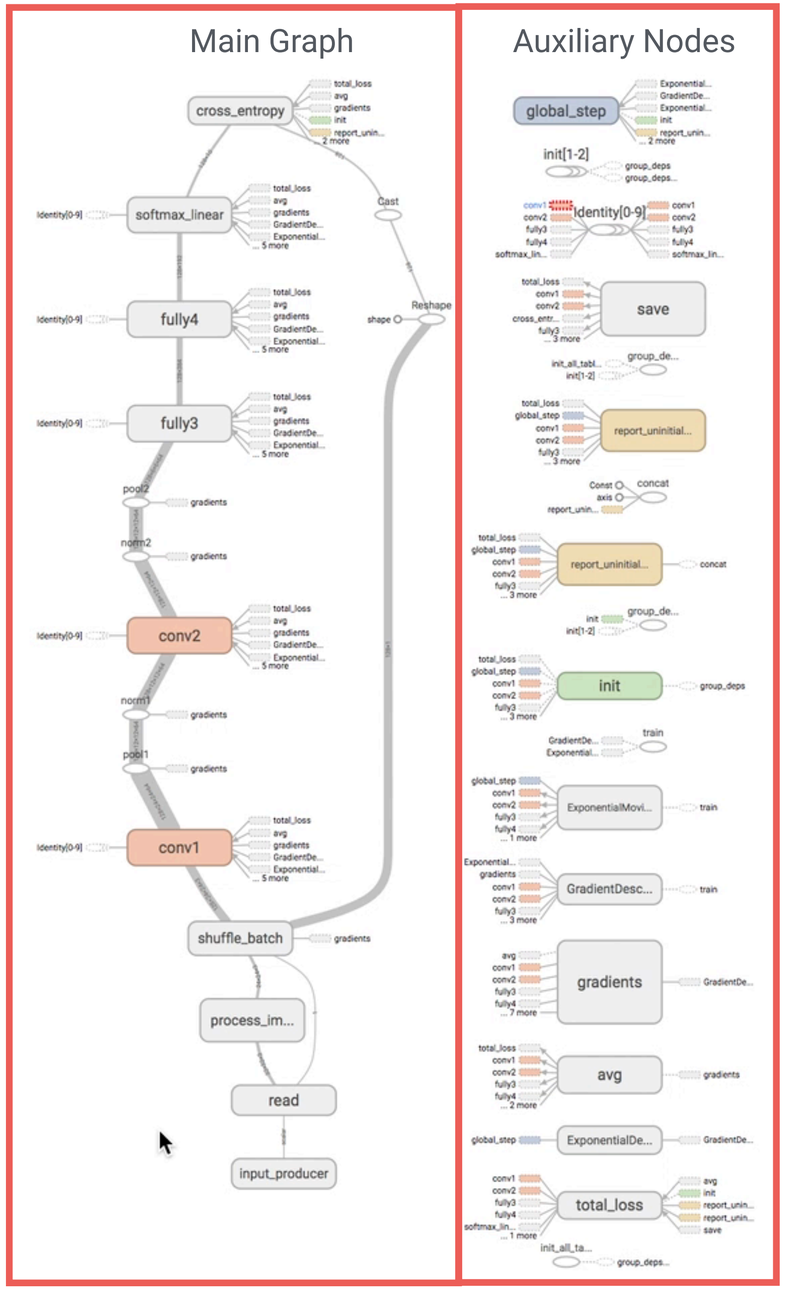

Auxiliary Nodes

less important operations that are extracted from the main graph

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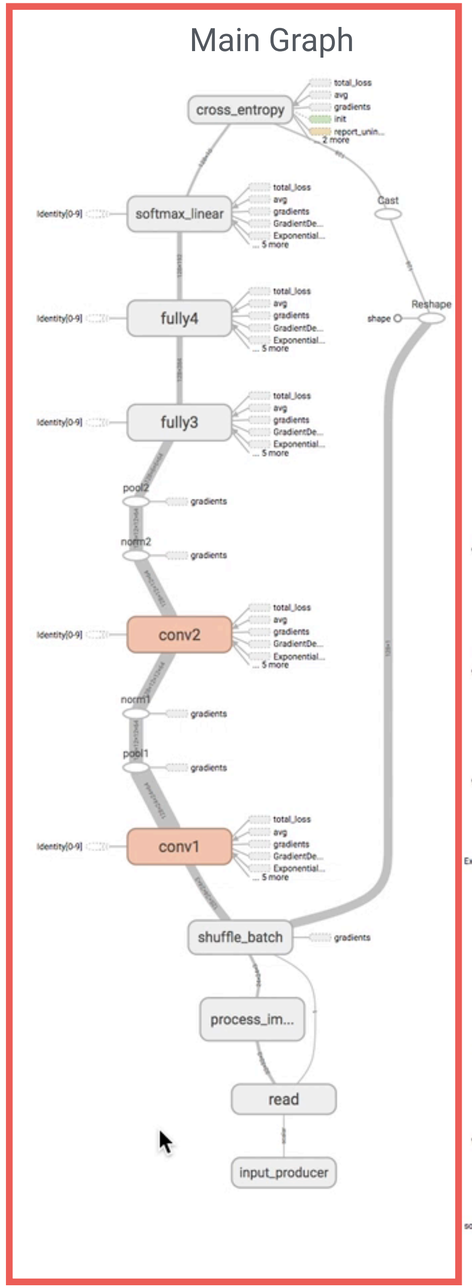

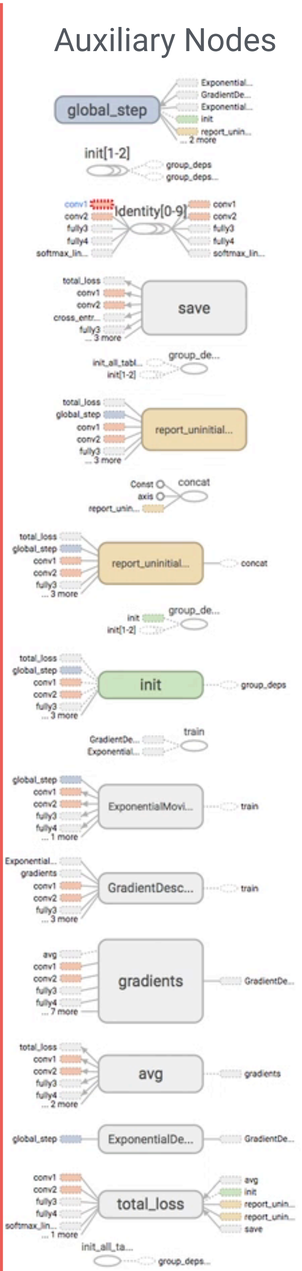

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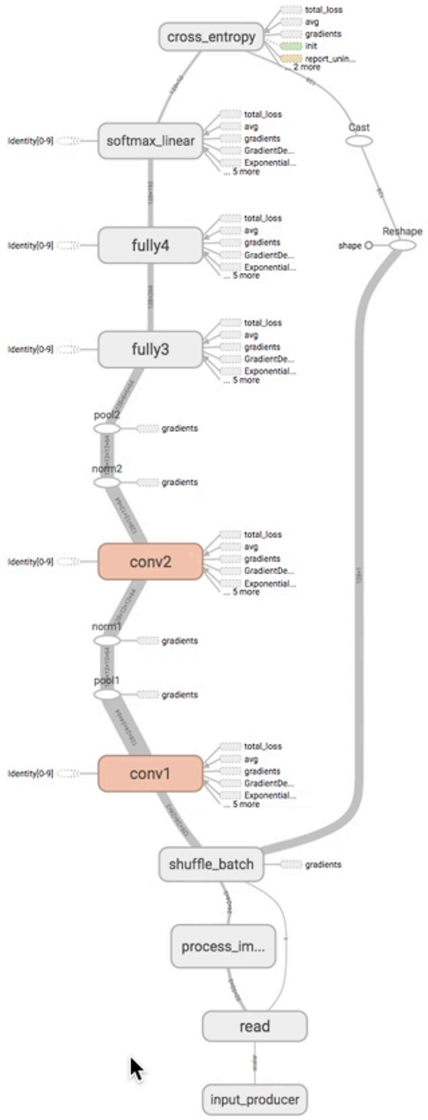
Flow Direction

Main Graph



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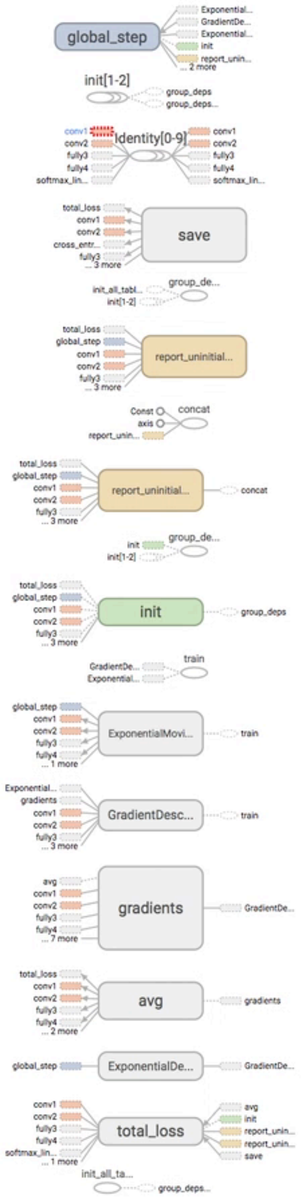

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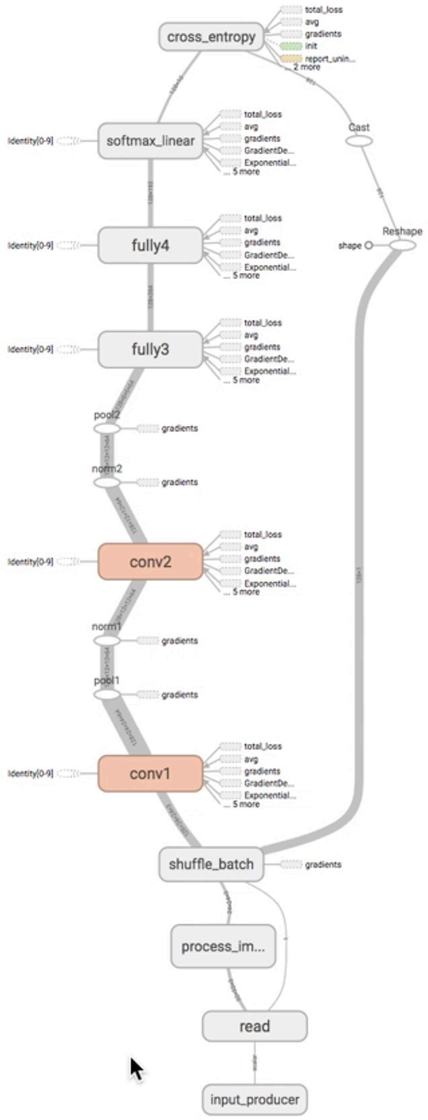

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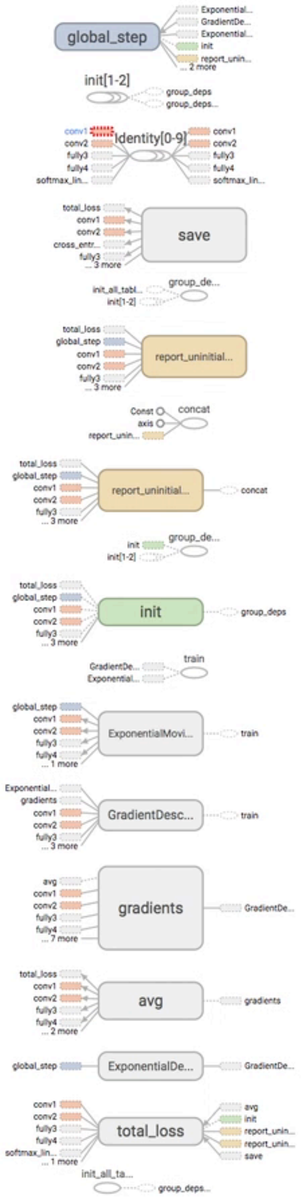

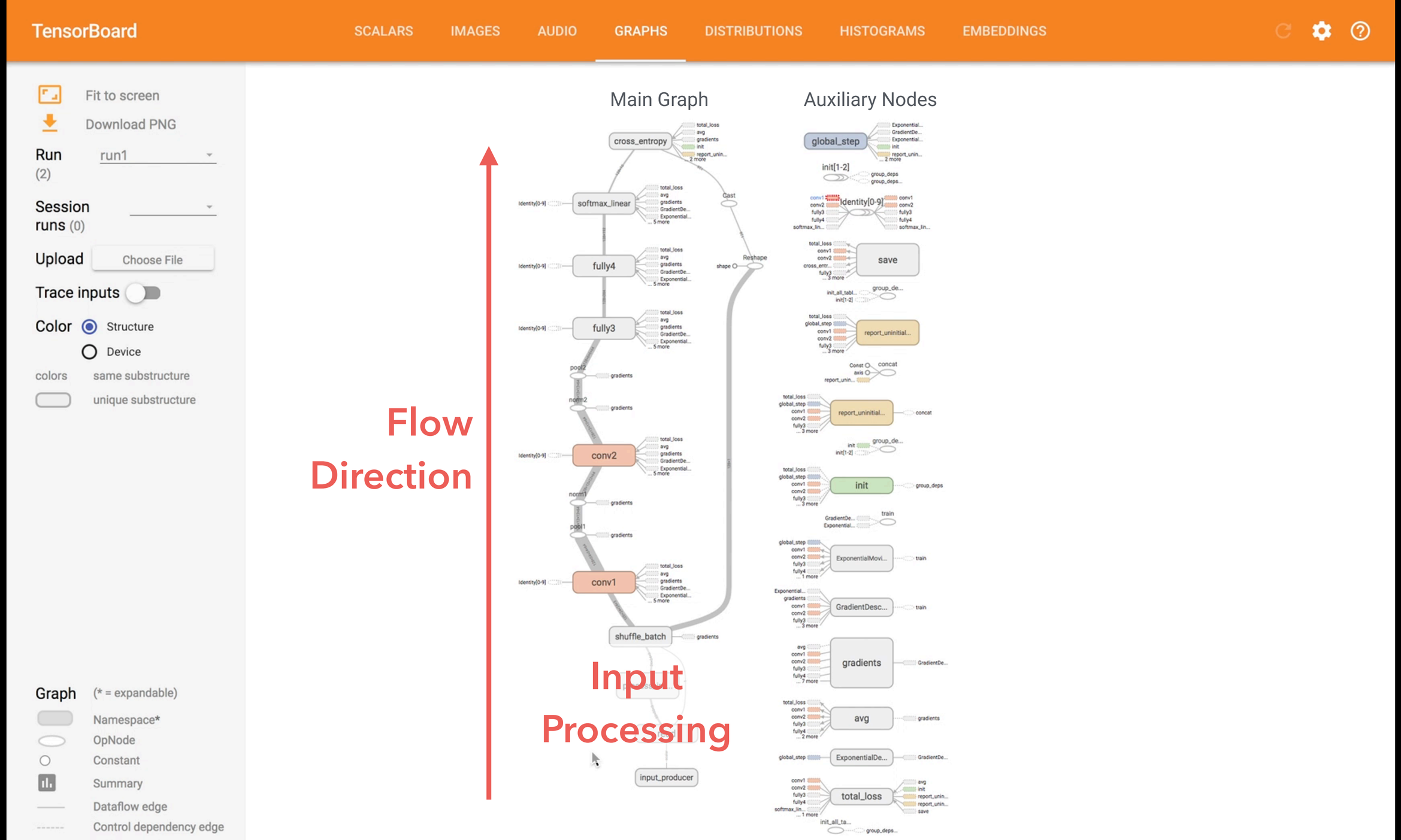
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cross_entropy
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input_producer
global_step
save
report_uninitial...
init
gradients
avg
total_loss

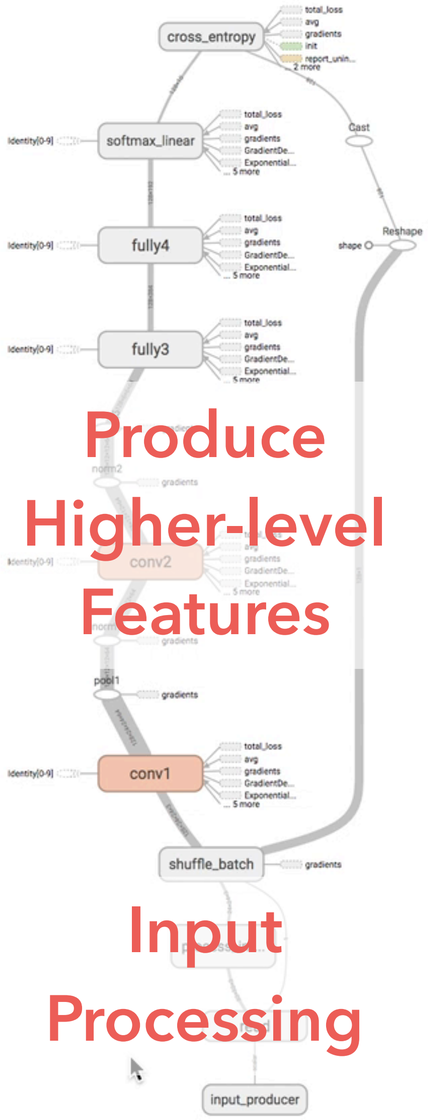
TensorBoard SCALARS IMAGES AUDIO GRAPHS DISTRIBUTIONS HISTOGRAMS EMBEDDINGS

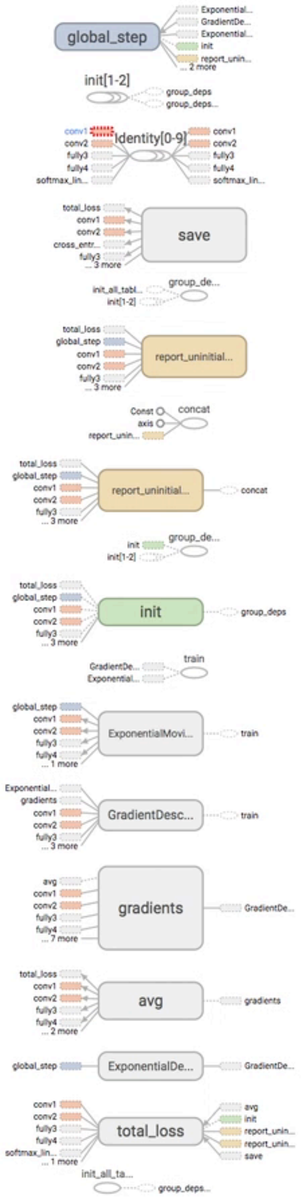
Fit to screen
Download PNG
Run (2) run1
Session runs (0)
Upload Choose File
Trace inputs
Color Structure
Device
colors same substructure
unique substructure

Graph (* = expandable)
Namespace*
OpNode
Constant
Summary
Dataflow edge
Control dependency edge
Reference edge

Main Graph

Auxiliary Nodes

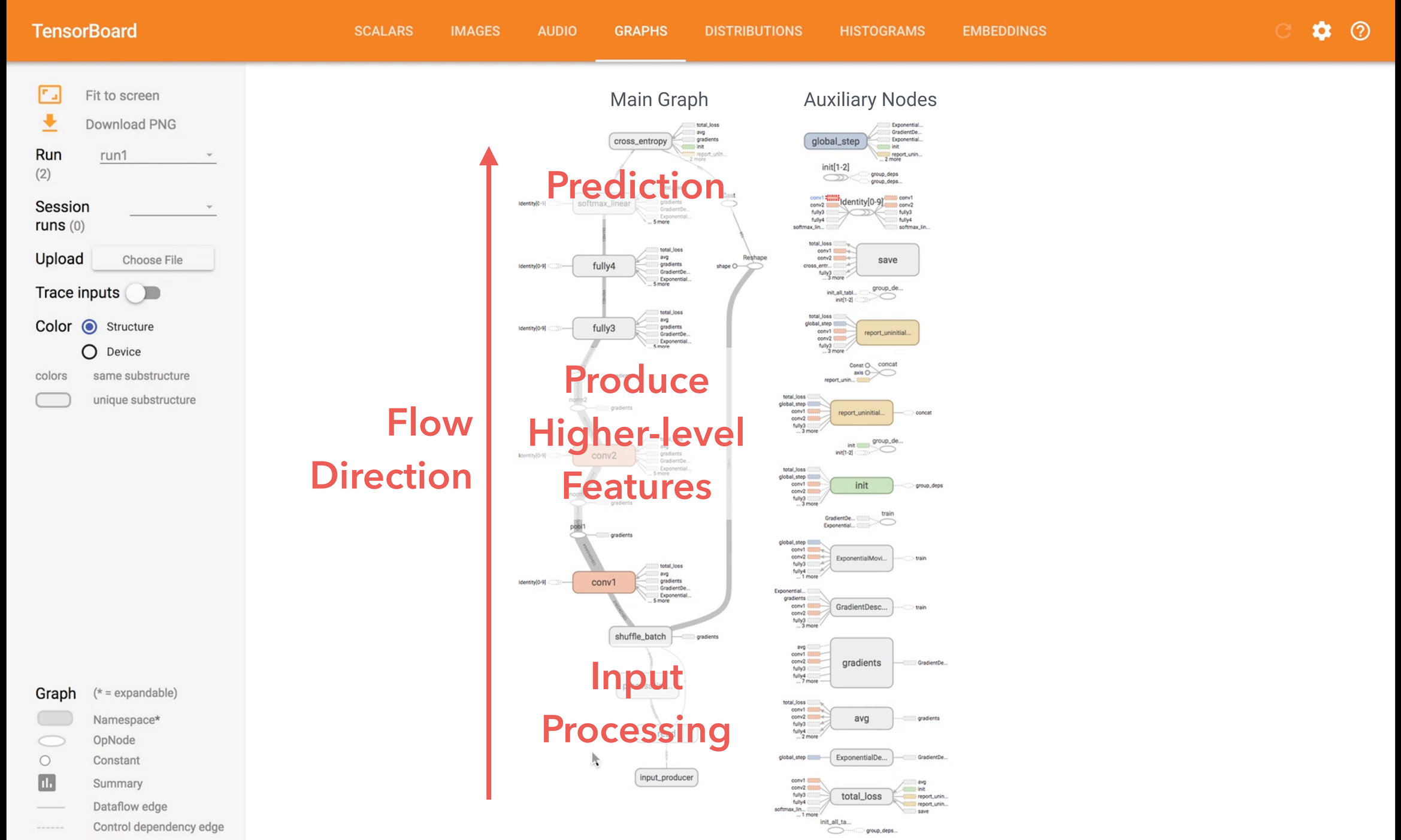




Flow Direction

Produce Higher-level Features

Input Processing


TensorBoard
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Fit to screen
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unique substructure
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Prediction
Produce Higher-level Features
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cross_entropy
softmax_linear
fully4
fully3
conv2
conv1
shuffle_batch
input_producer
Reshape
global_step
init[1-2]
Identity[0-9]
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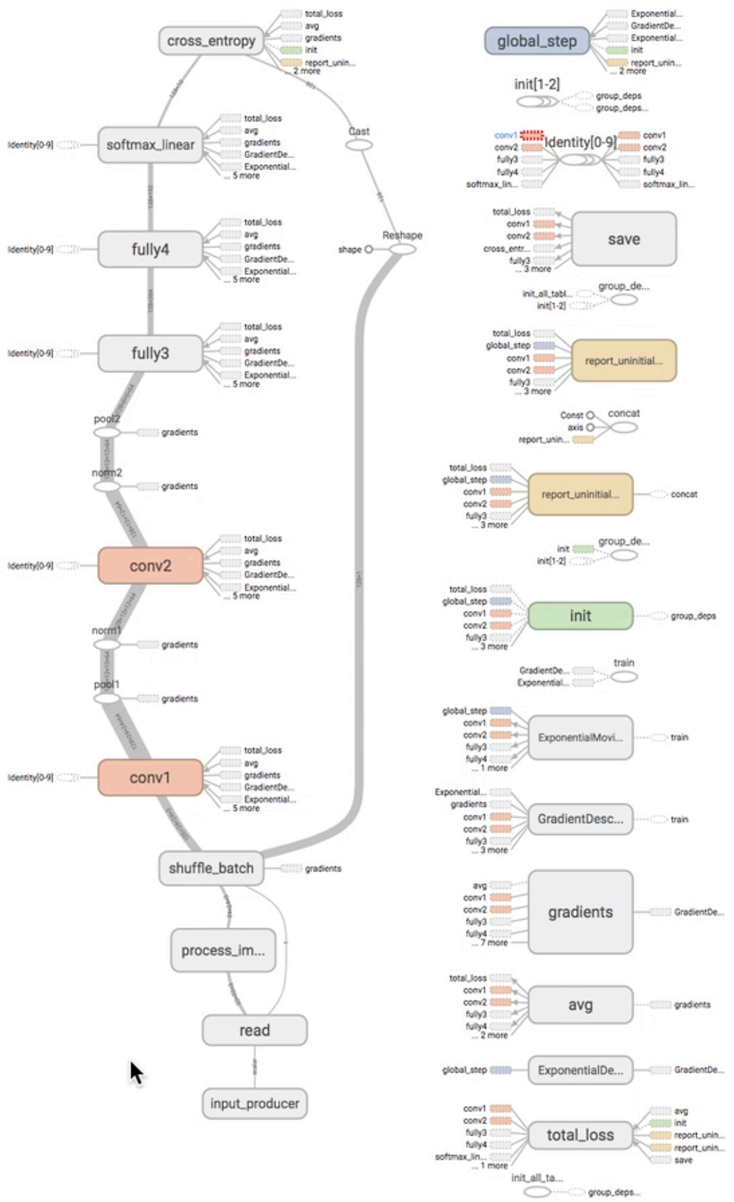
GradientDesc...
gradients
avg
ExponentialDe...
total_loss

TensorBoard SCALARS IMAGES AUDIO GRAPHS DISTRIBUTIONS HISTOGRAMS EMBEDDINGS

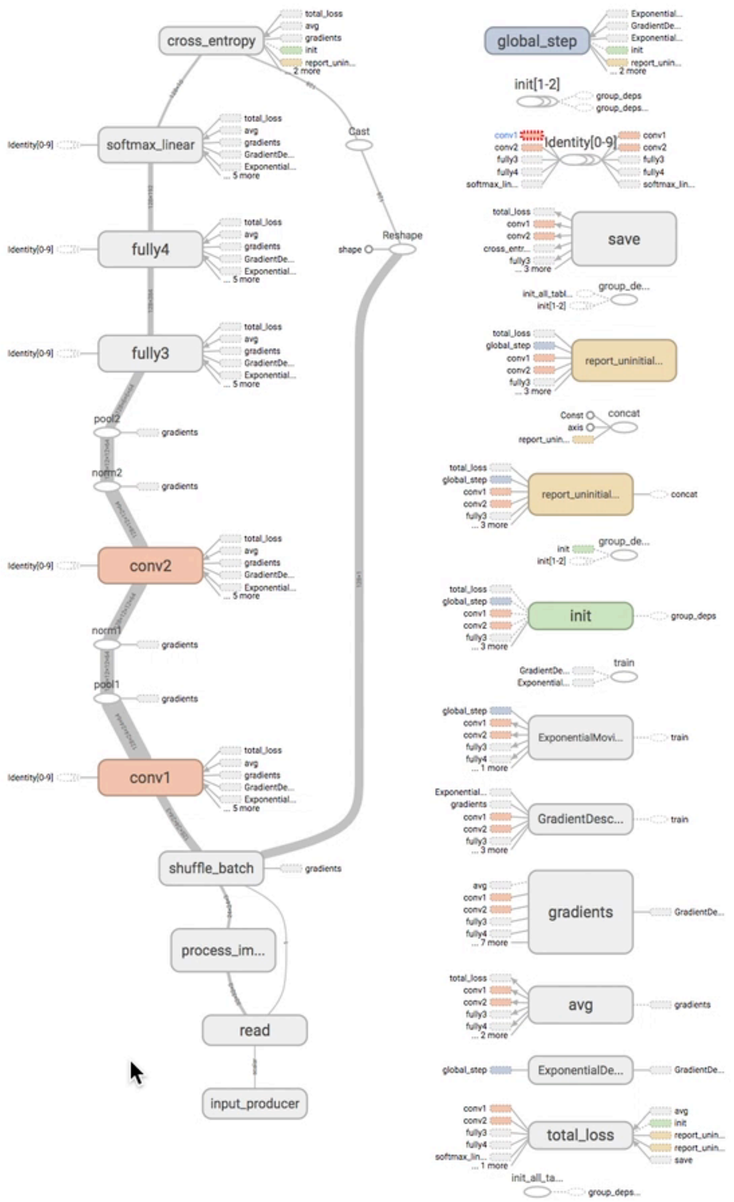
Fit to screen
Download PNG
Run (2) run1
Session runs (0)
Upload Choose File
Trace inputs
Color Structure Device
colors same substructure
unique substructure



Graph (* = expandable)
Namespace*
OpNode
Constant
Summary
Dataflow edge
Control dependency edge
Reference edge

TensorBoard SCALARS IMAGES AUDIO GRAPHS DISTRIBUTIONS HISTOGRAMS EMBEDDINGS

Fit to screen
Download PNG
Run (2) run1
Session runs (0)
Upload Choose File
Trace inputs
Color Structure Device
colors same substructure
unique substructure



Graph (* = expandable)
Namespace*
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Summary
Dataflow edge
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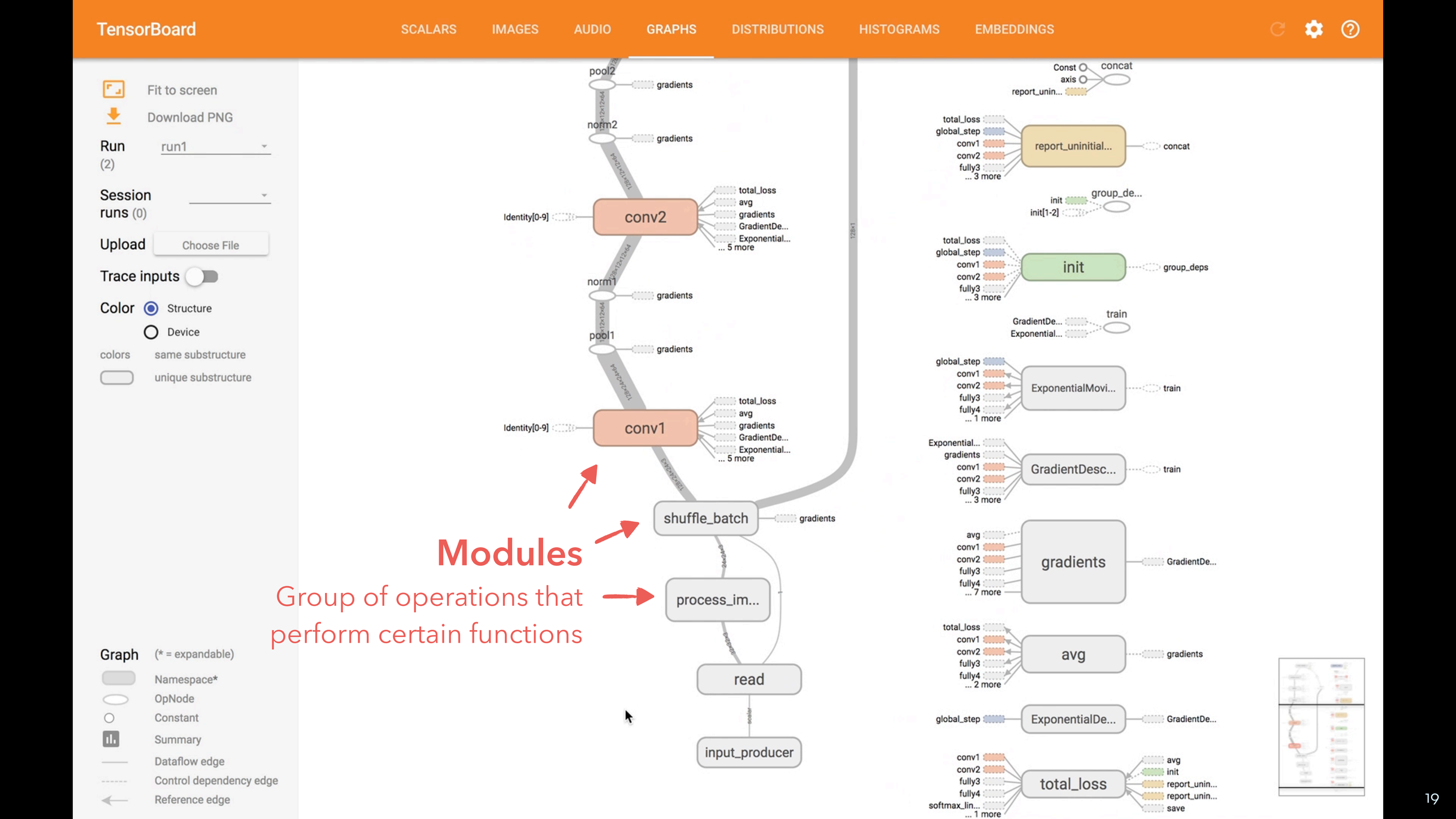
Reference edge


TensorBoard
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Fit to screen
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Run (2)
run1
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Device
colors
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unique substructure
Graph
(* = expandable)
Namespace*
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gradients
conv2
Identity[0-9]
total_loss
avg
gradients
GradientDe...
Exponential...
... 5 more
norm1
gradients
pool1
gradients
conv1
Identity[0-9]
total_loss
avg
gradients
GradientDe...
Exponential...
... 5 more
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gradients
process_im...
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Group of operations that perform certain functions
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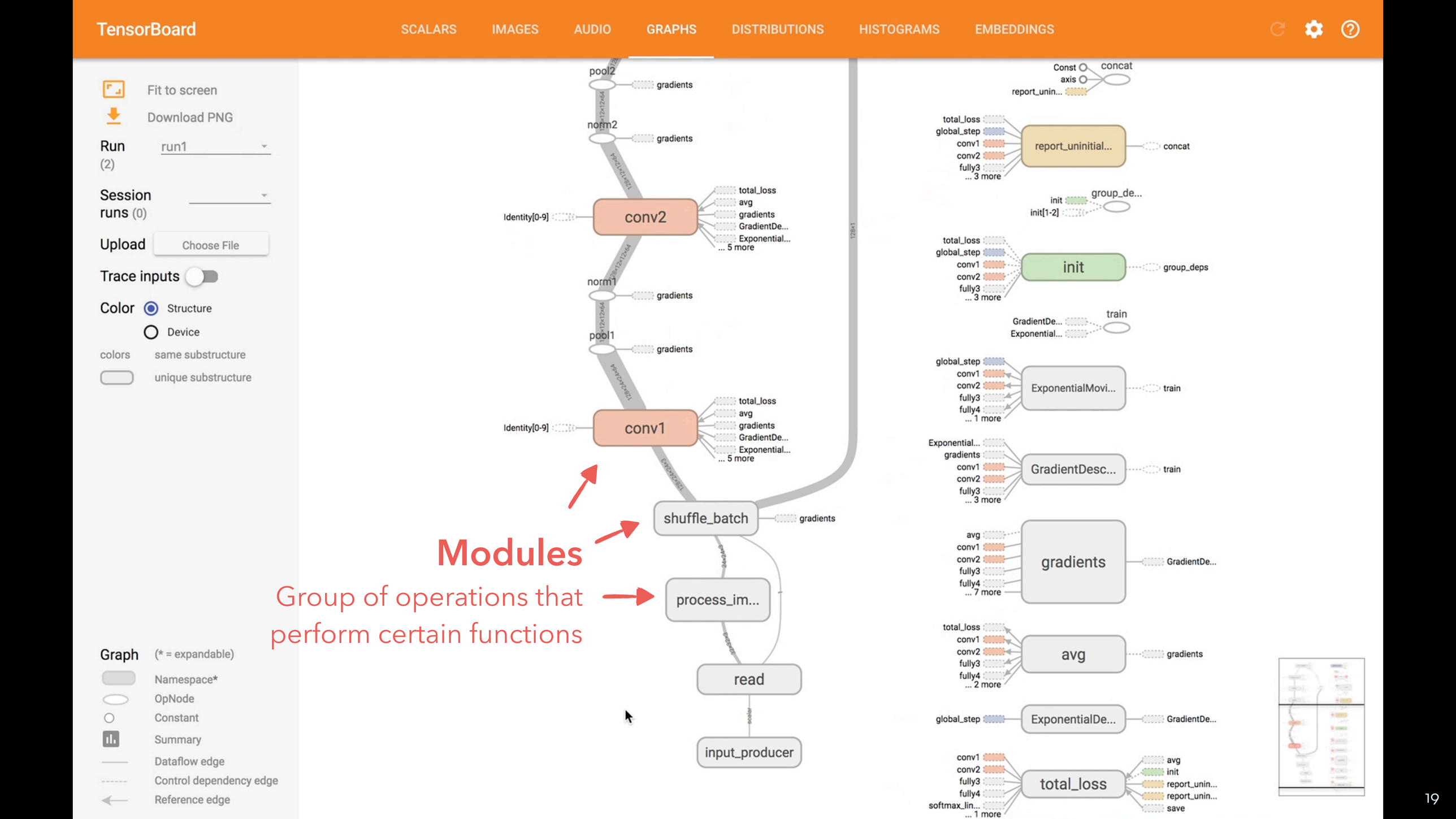
global_step
conv1
conv2
fully3
... 3 more
report_uninitial...
concat
init
init[1-2]
group_de...
init
group_deps
train
GradientDe...
Exponential...
ExponentialMovi...
train
fully4
... 1 more
GradientDesc...
... 3 more
gradients
... 7 more
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
... 1 more
save


TensorBoard
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gradients
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... 5 more
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gradients
pool1
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conv1
Identity[0-9]
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conv1
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... 3 more
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init
init[1-2]
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init
group_deps
train
GradientDe...
Exponential...
ExponentialMovi...
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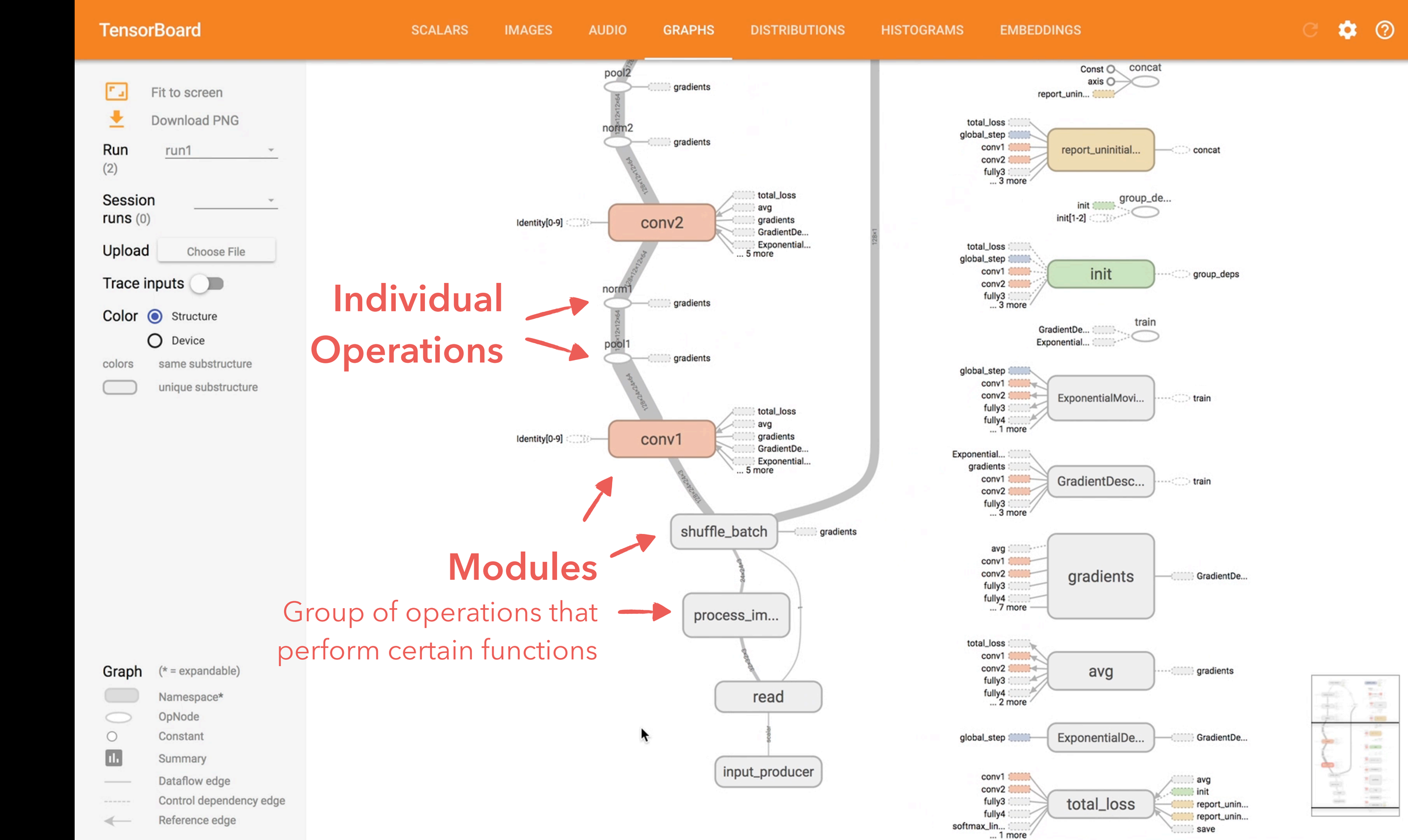
fully4
... 1 more
GradientDesc...
... 3 more
gradients
... 7 more
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
... 1 more
save


TensorBoard
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gradients
conv2
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gradients
GradientDe...
Exponential...
... 5 more
norm1
gradients
pool1
gradients
conv1
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Exponential...
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GradientDesc...
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fully3
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... 7 more
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GradientDe...
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conv1
conv2
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fully4
... 2 more
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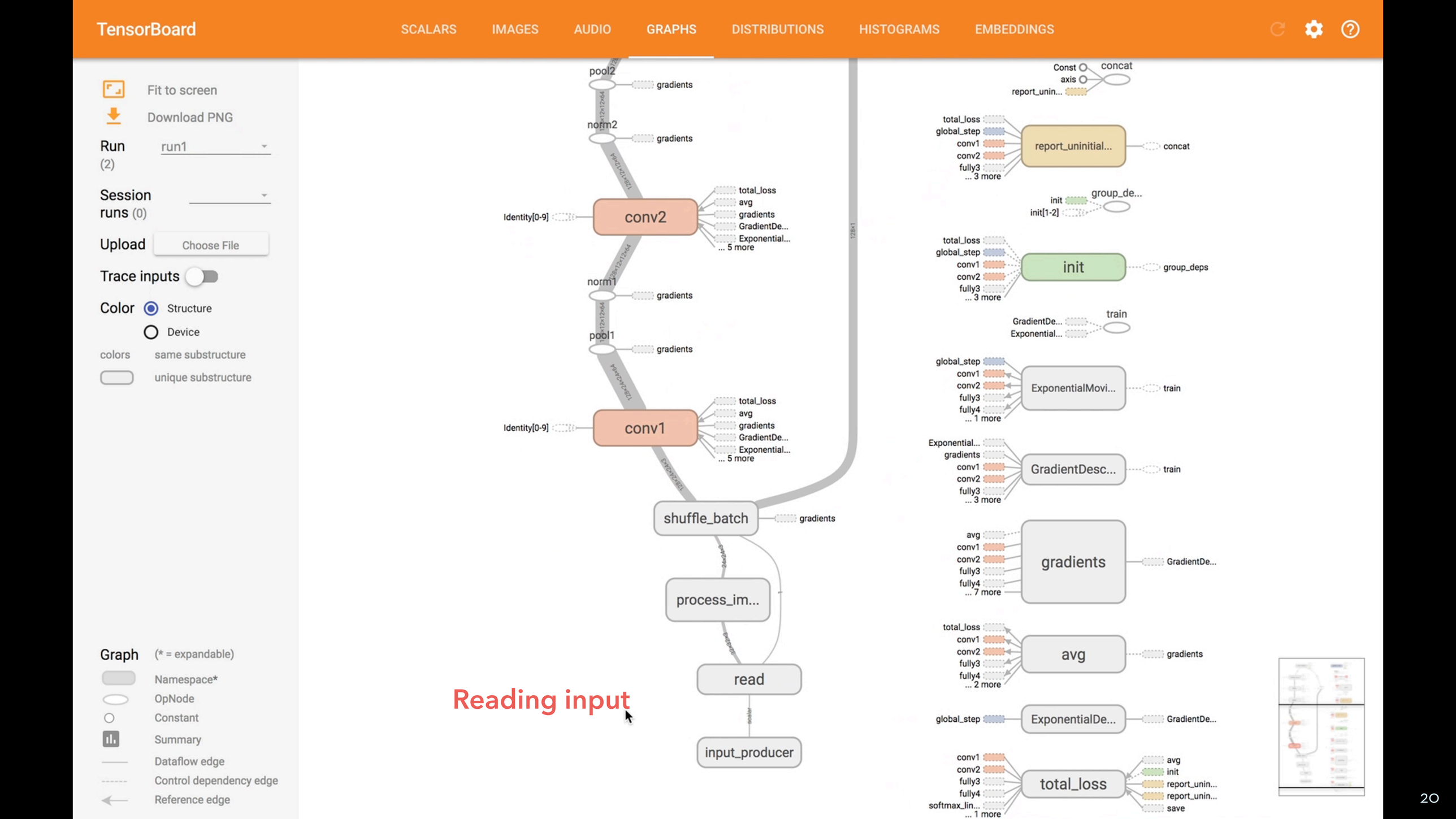
gradients
global_step
ExponentialDe...
GradientDe...
conv1
conv2
fully3
fully4
softmax_lin...
... 1 more
total_loss
avg
init
report_unin...
report_unin...
save


TensorBoard
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Exponential...
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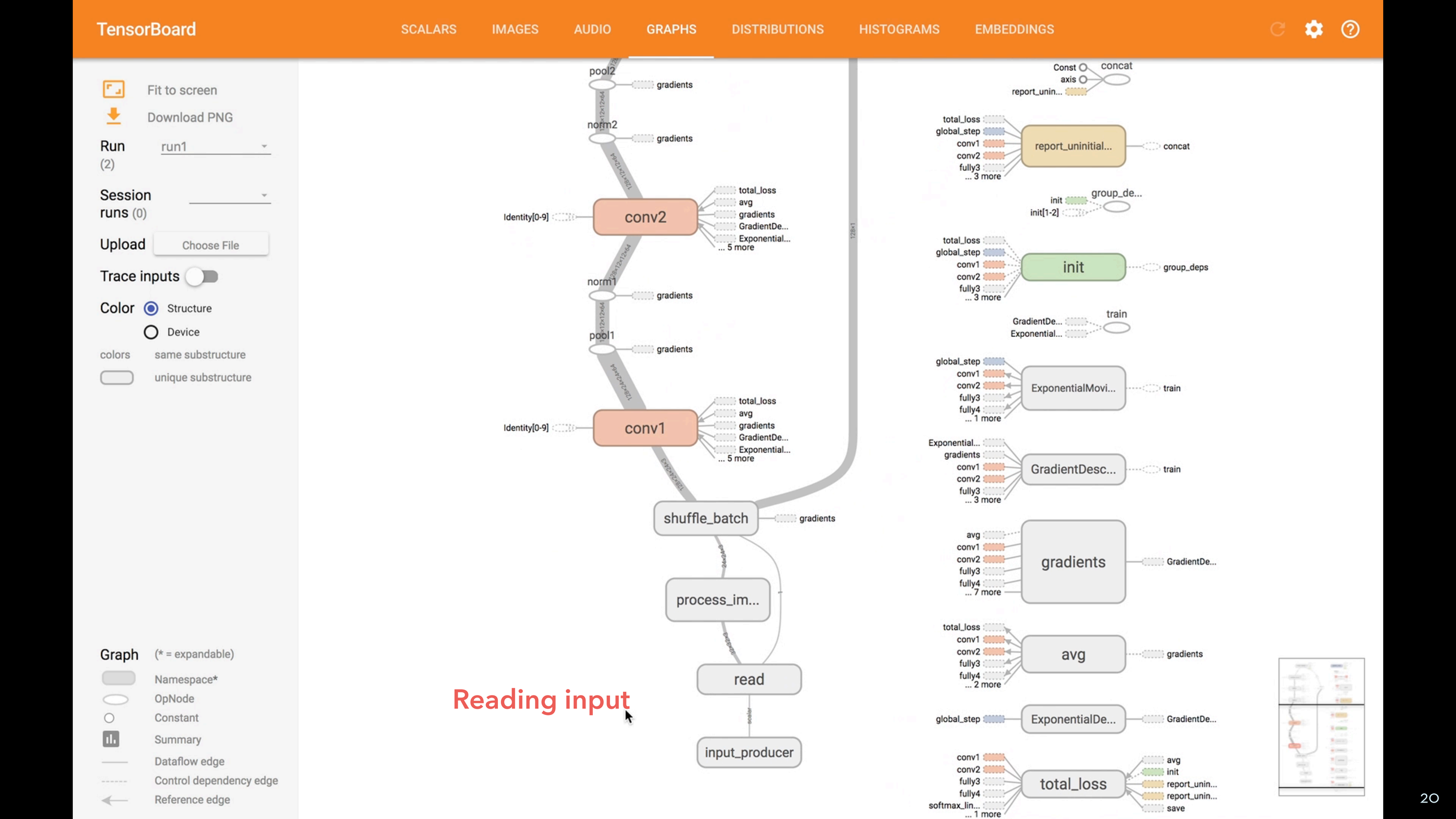
ExponentialMovi...
train
fully4
... 1 more
GradientDesc...
... 7 more
gradients
GradientDe...
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
save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Exponential...
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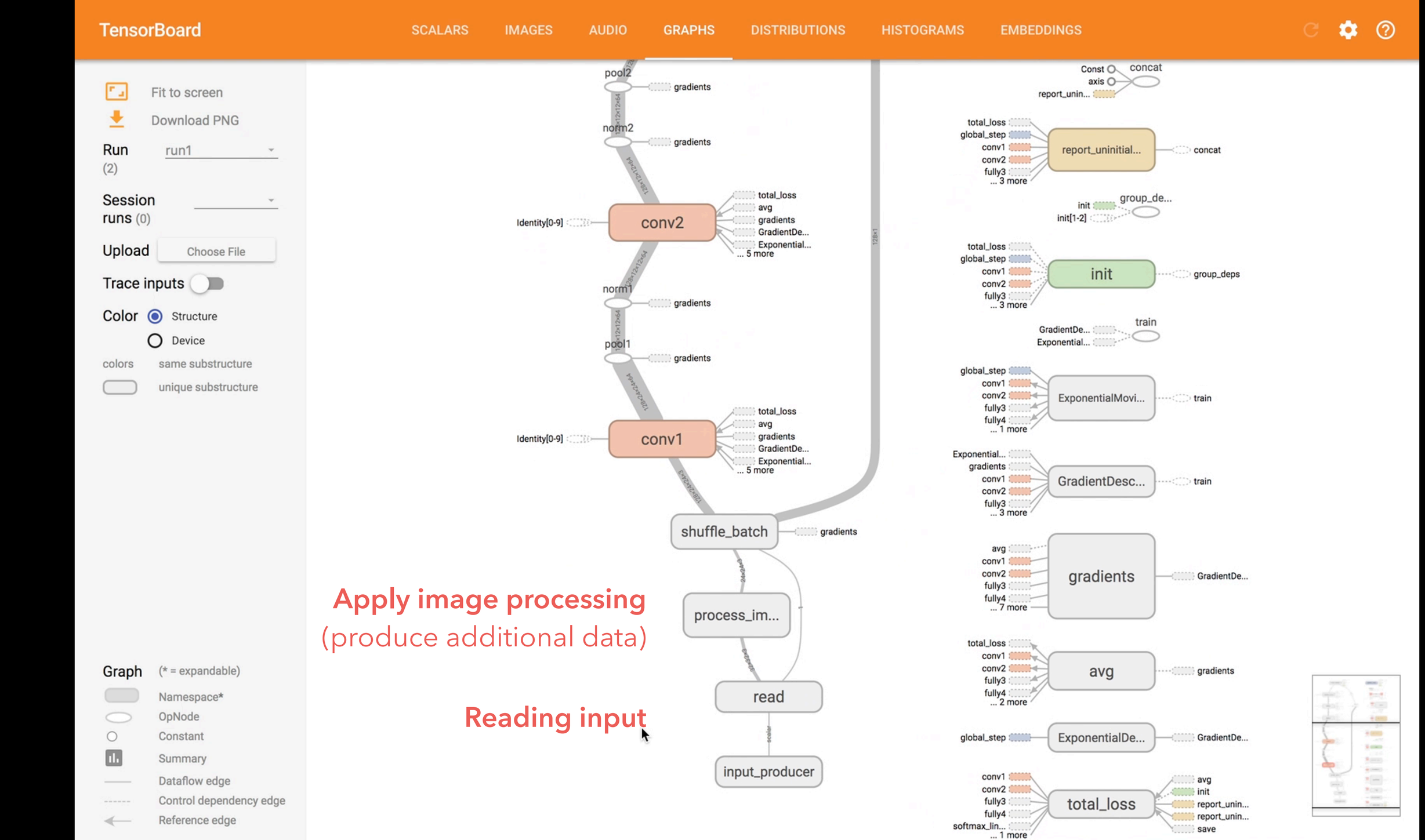
GradientDe...
Exponential...
ExponentialMovi...
train
fully4
... 1 more
GradientDesc...
... 7 more
gradients
GradientDe...
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
save


TensorBoard
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Exponential...
... 5 more
Identity[0-9]
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read
input_producer
Apply image processing
(produce additional data)
Reading input
Const
axis
concat
report_unin...
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report_uninitial...
concat
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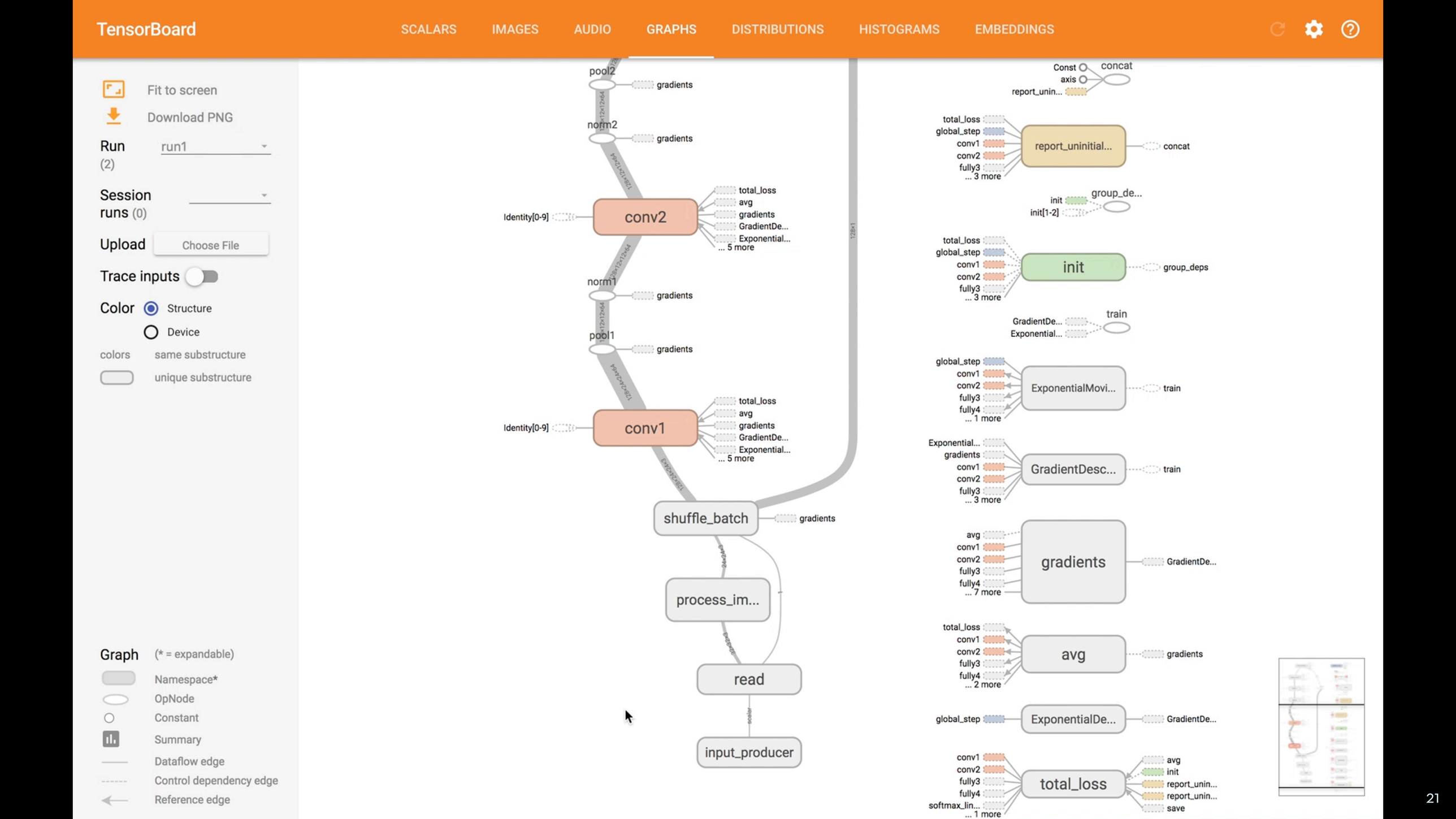
... 1 more
GradientDesc...
... 3 more
gradients
GradientDe...
... 7 more
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
save


TensorBoard
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GradientDesc...
... 3 more
gradients
GradientDe...
... 7 more
avg
... 2 more
ExponentialDe...
total_loss
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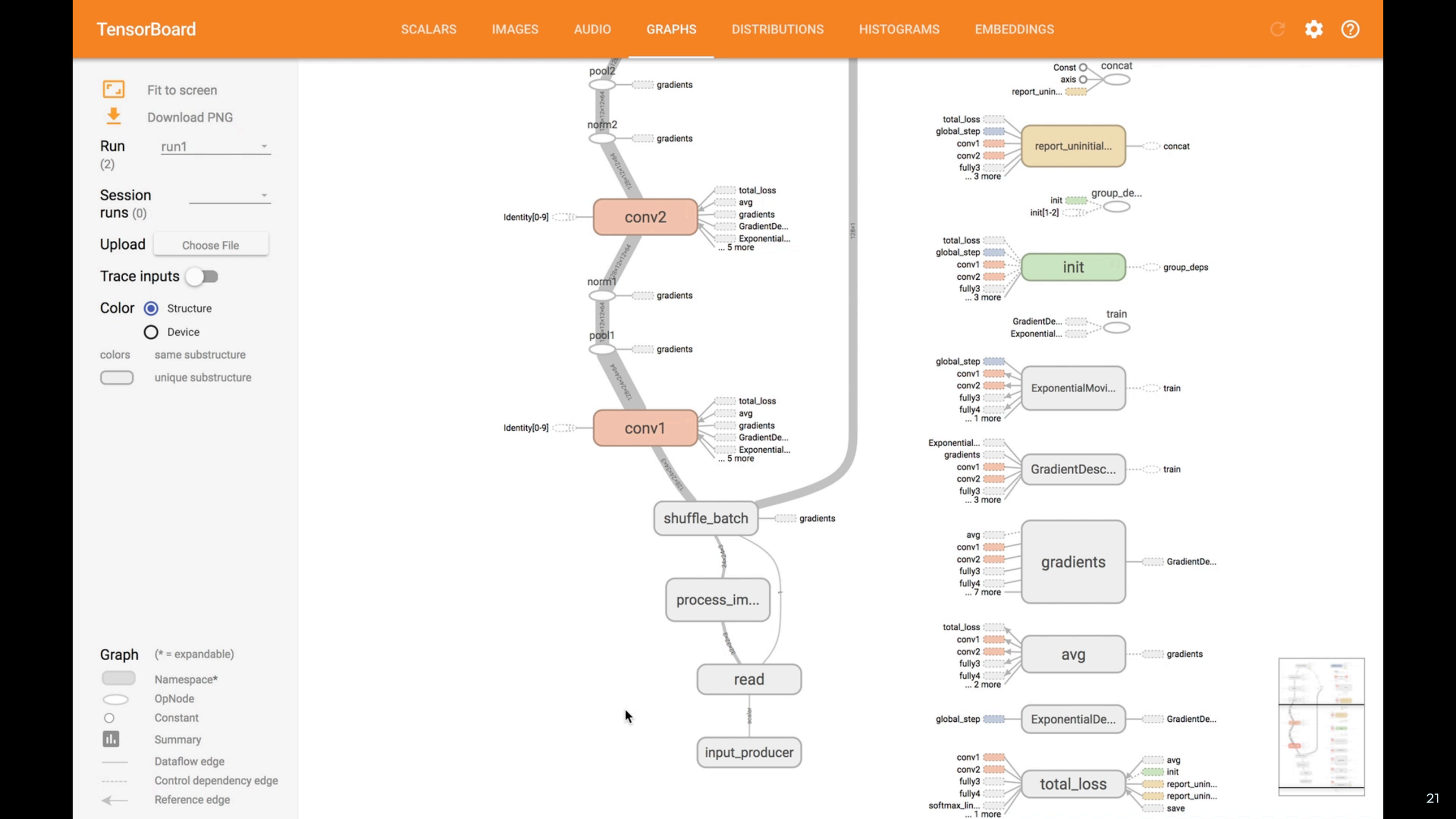
save
... 1 more


TensorBoard
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run1
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Exponential...
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gradients
pool1
gradients
conv1
total_loss
avg
gradients
GradientDe...
Exponential...
... 5 more
Identity[0-9]
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input_producer
Const
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concat
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fully3
... 3 more
report_uninitial...
concat
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init[1-2]
init
group_deps
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GradientDe...
Exponential...
ExponentialMovi...
train
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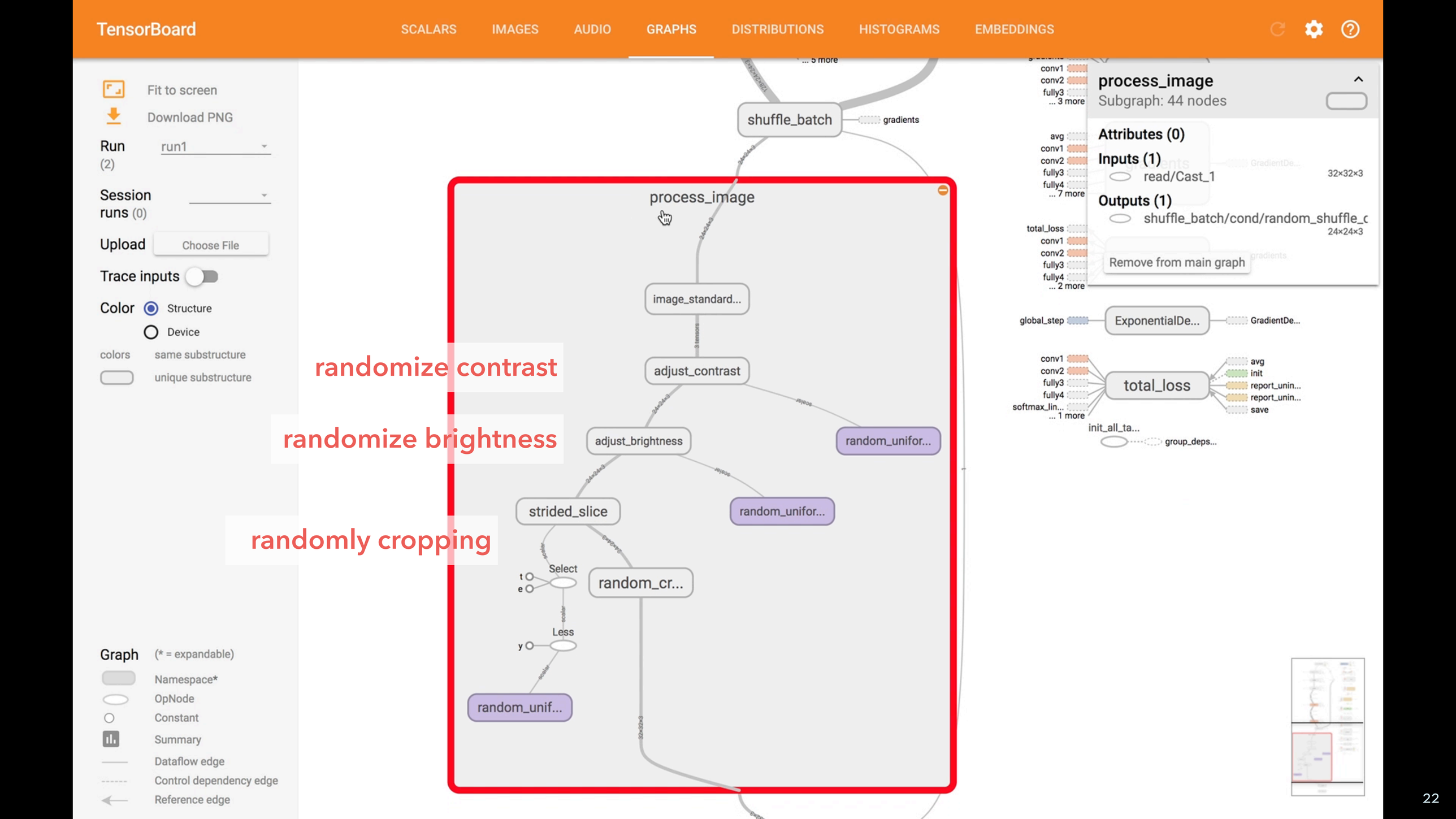
... 1 more
GradientDesc...
... 3 more
gradients
GradientDe...
... 7 more
avg
... 2 more
ExponentialDe...
total_loss
softmax_lin...
save
... 1 more


TensorBoard
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randomize brightness
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strided_slice
random_unifor...
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process_image
Subgraph: 44 nodes
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Outputs (1)
shuffle_batch/cond/random_shuffle_c
24×24×3
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GradientDe...
total_loss
init_all_ta...
group_deps...
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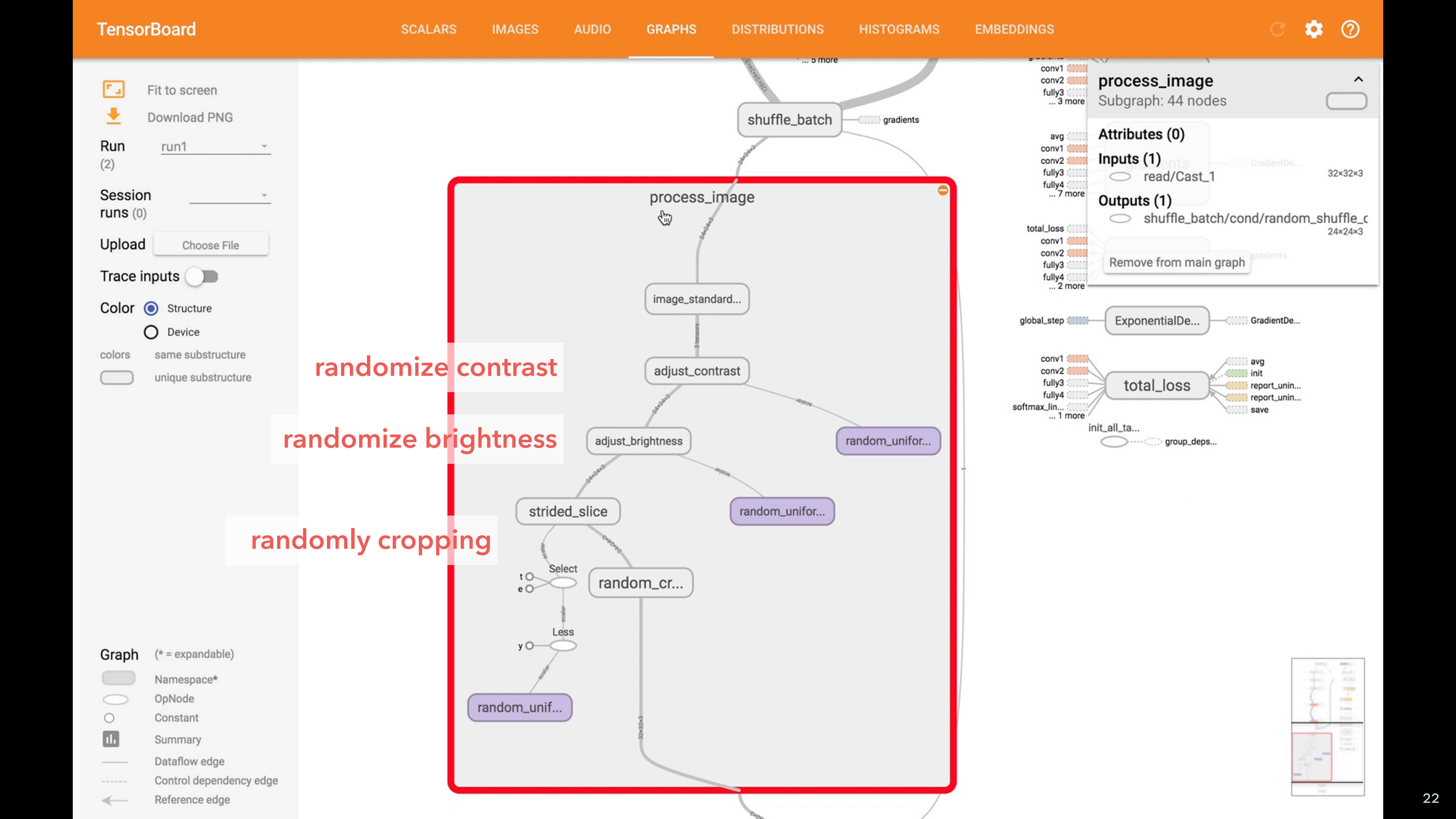
TensorBoard
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randomize brightness
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adjust_contrast
adjust_brightness
random_unifor...
strided_slice
random_unifor...
Select
random_cr...
Less
random_unif...
process_image
Subgraph: 44 nodes
Attributes (0)
Inputs (1)
read/Cast_1
32×32×3
Outputs (1)
shuffle_batch/cond/random_shuffle_c
24×24×3
Remove from main graph
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ExponentialDe...
GradientDe...
total_loss
init_all_ta...
group_deps...
Graph
(* = expandable)
Namespace*
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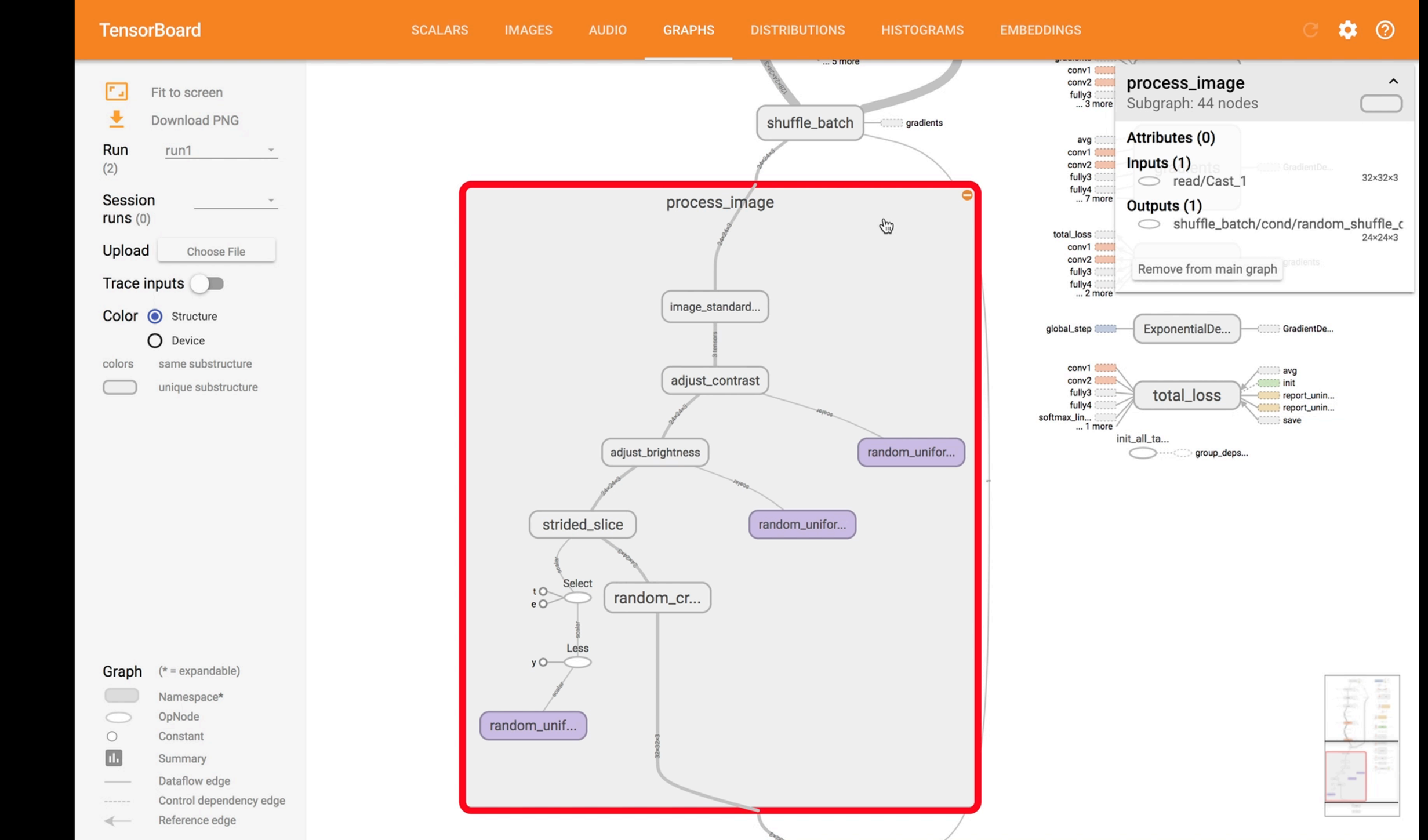
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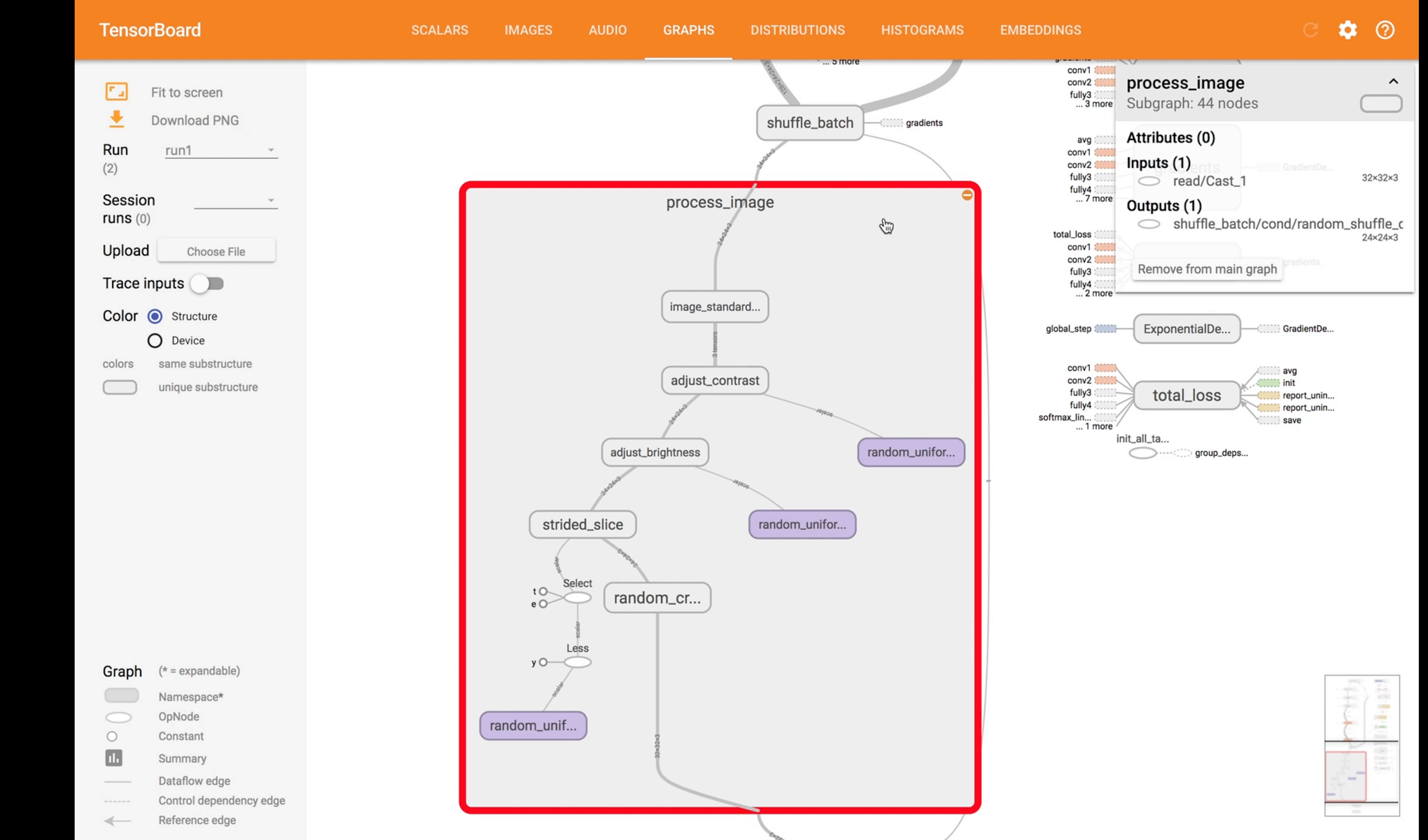
Outputs (1)
shuffle_batch/cond/random_shuffle_c
24×24×3
Remove from main graph
global_step
ExponentialDe...
GradientDe...
total_loss
avg
init
report_unin...
report_unin...
save
init_all_ta...
group_deps...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Fit to screen
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Run (2)
run1
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Attributes (0)
Inputs (1)
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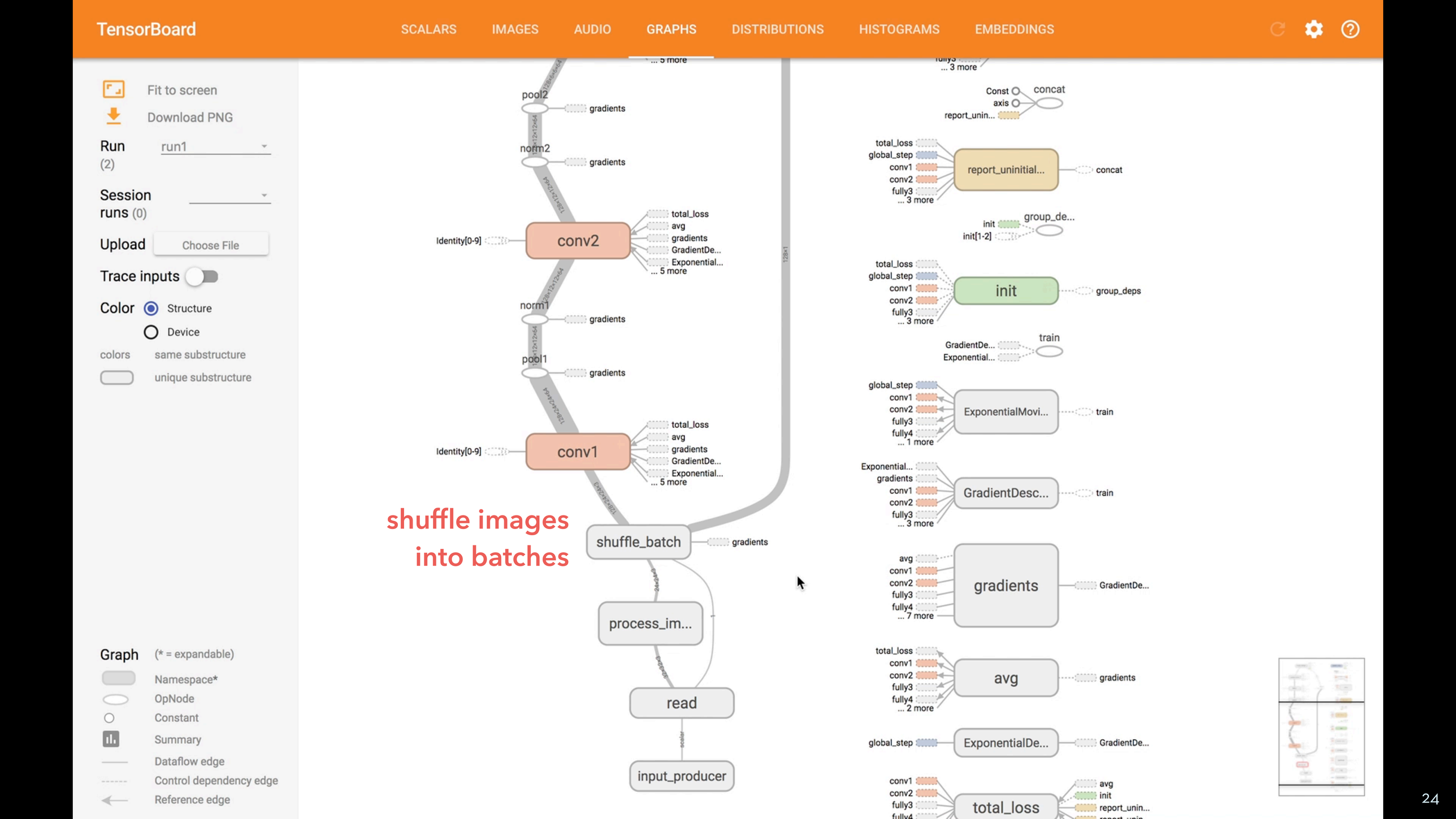
32×32×3
Outputs (1)
shuffle_batch/cond/random_shuffle_c
24×24×3
Remove from main graph
global_step
ExponentialDe...
GradientDe...
total_loss
avg
init
report_unin...
report_unin...
save
init_all_ta...
group_deps...


TensorBoard
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Fit to screen
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Run (2)
run1
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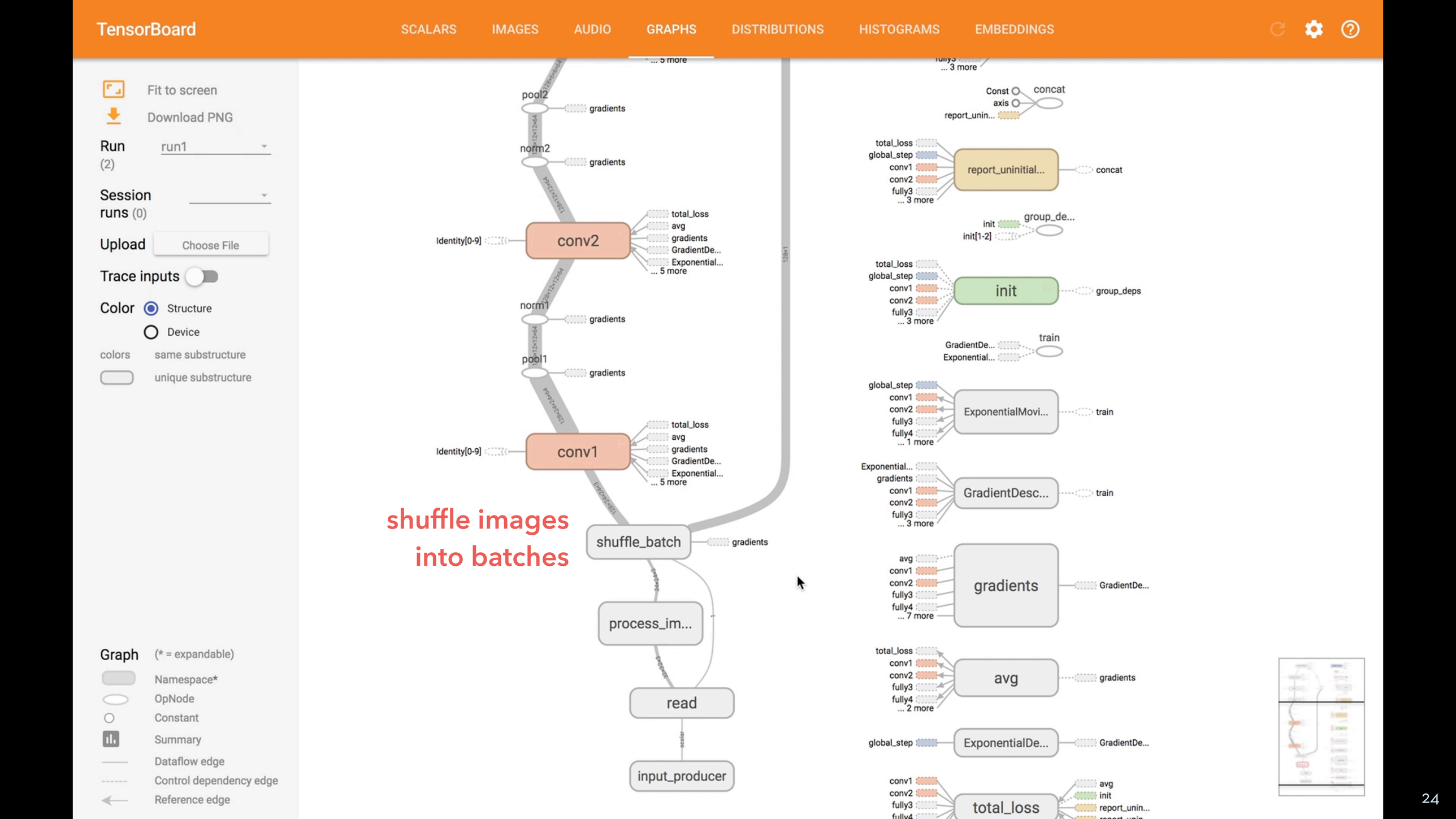
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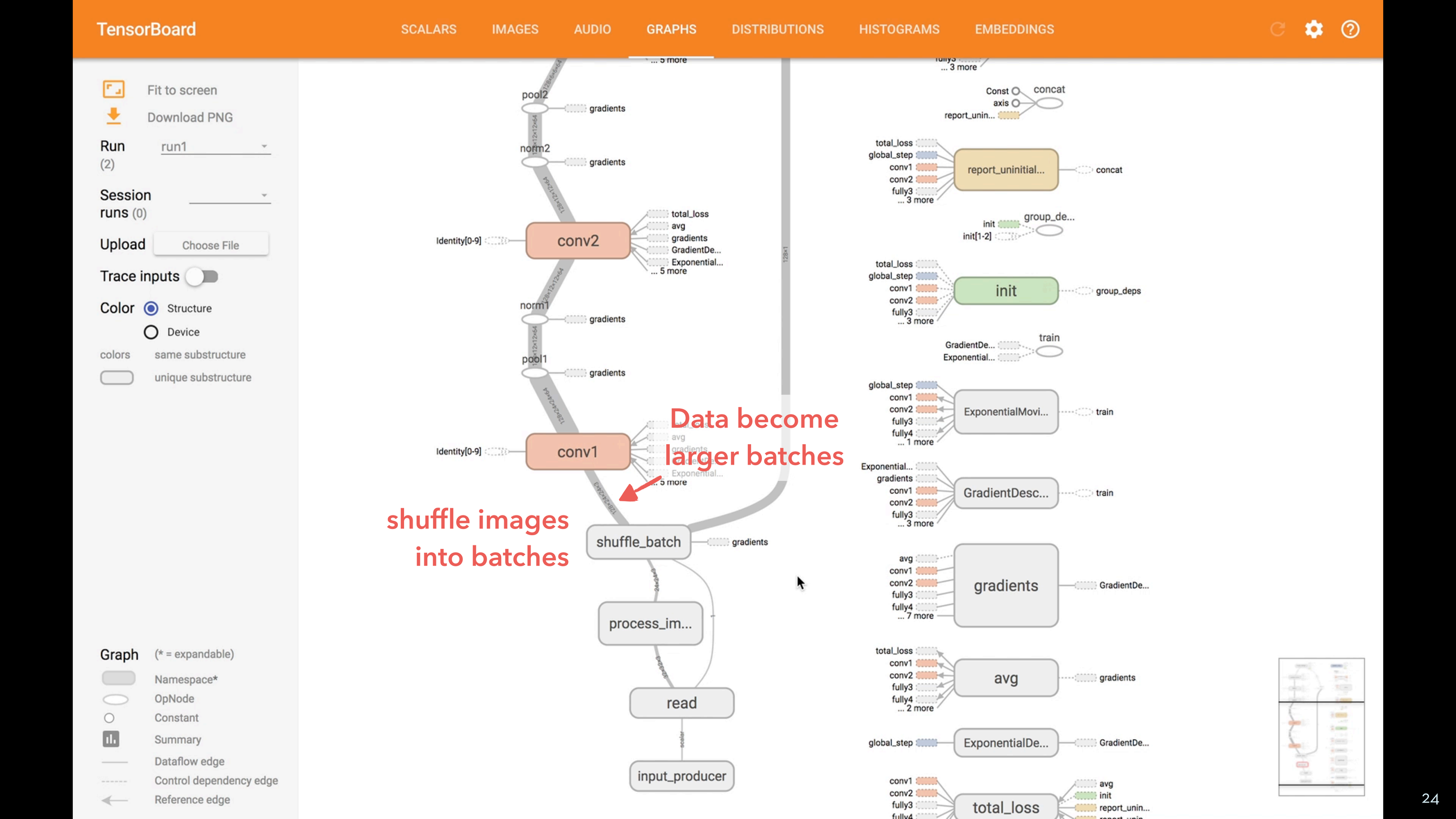
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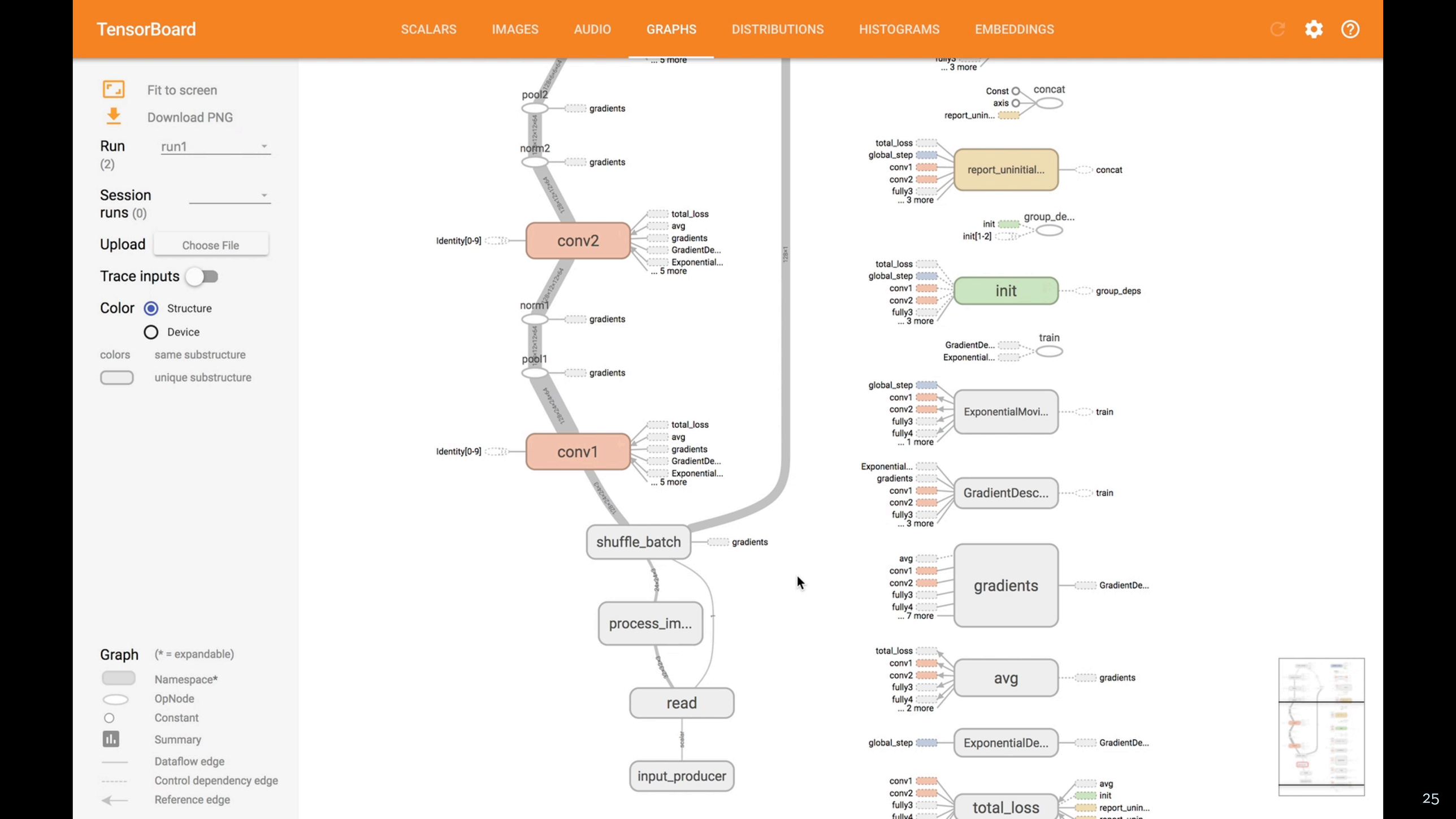
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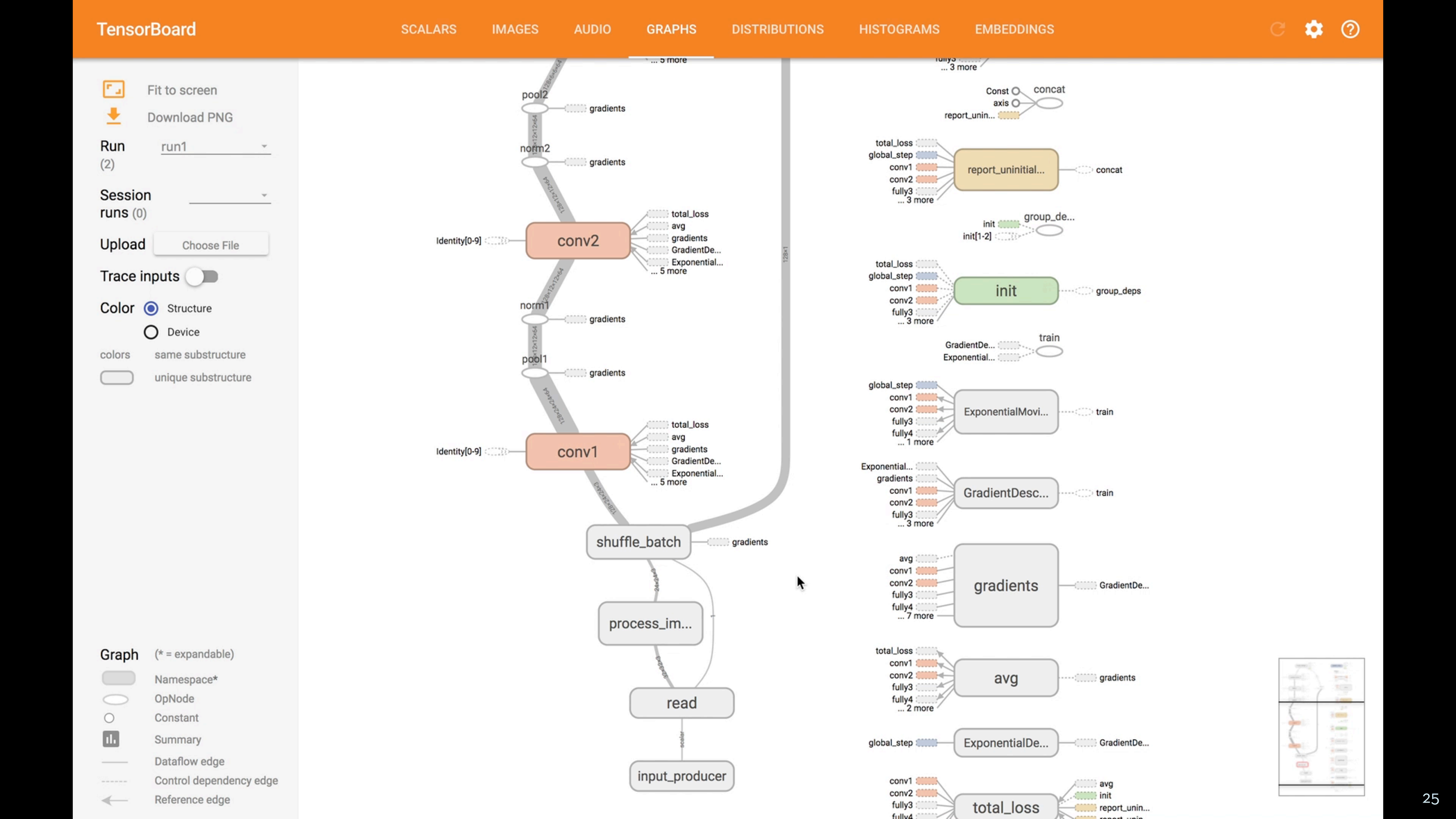
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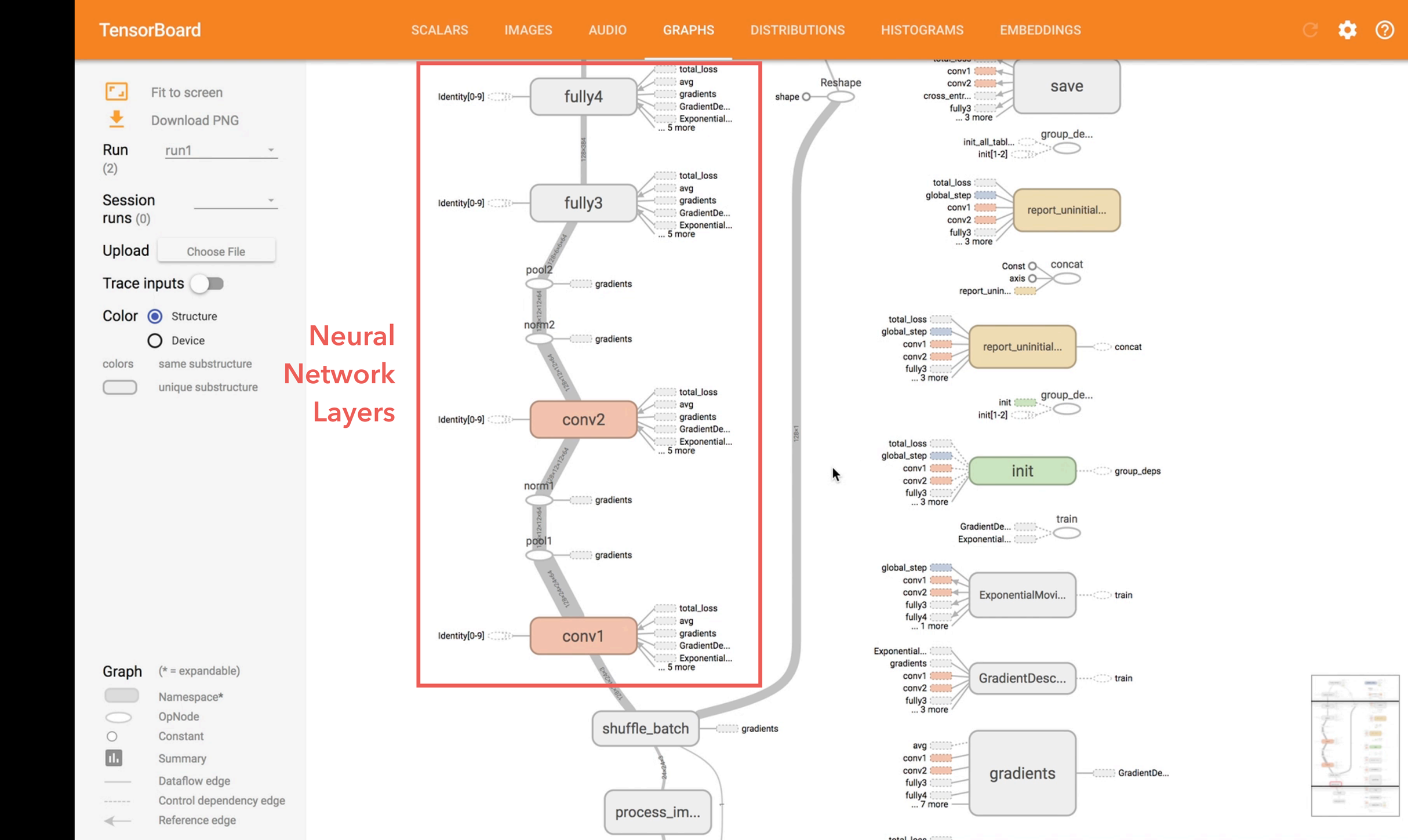
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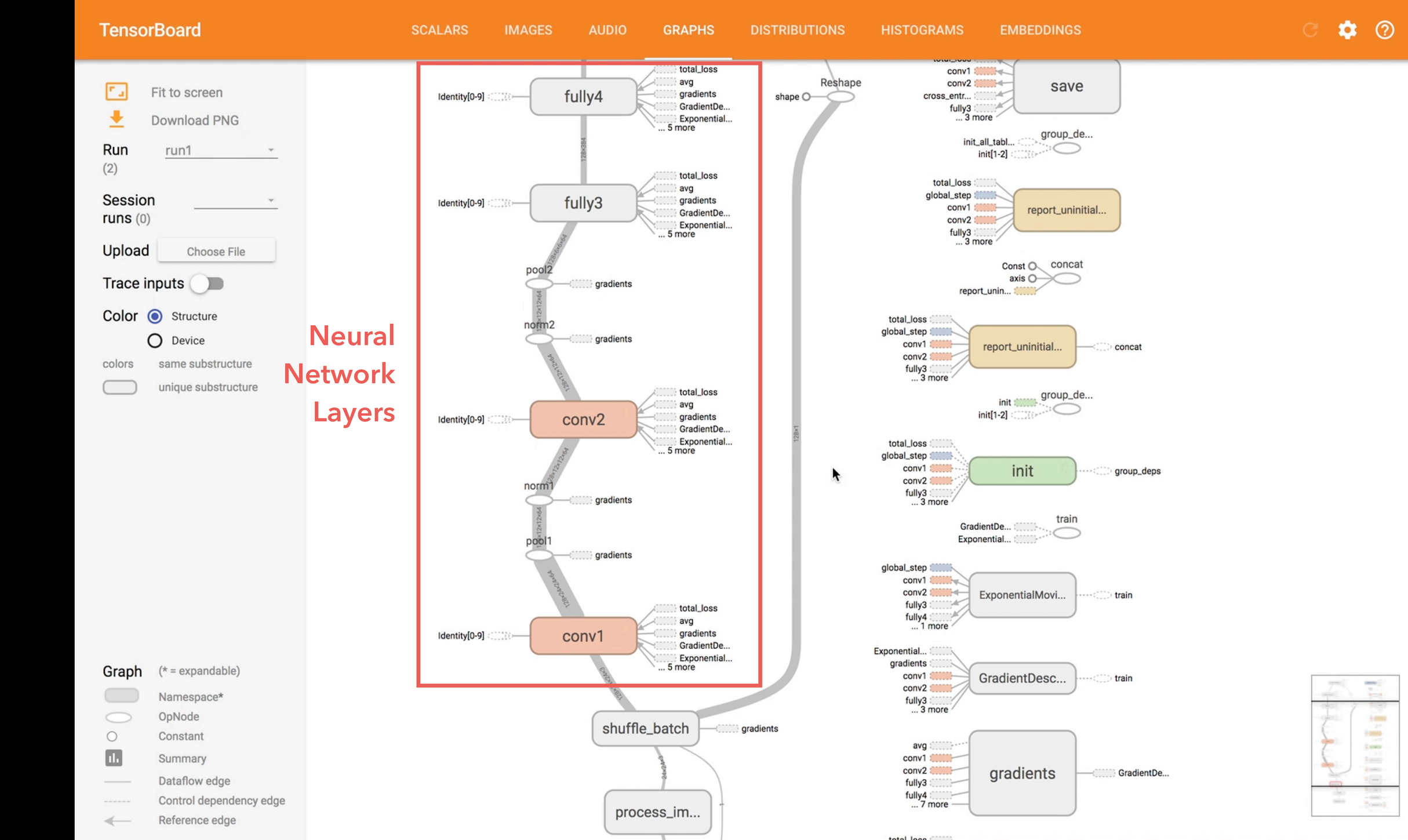
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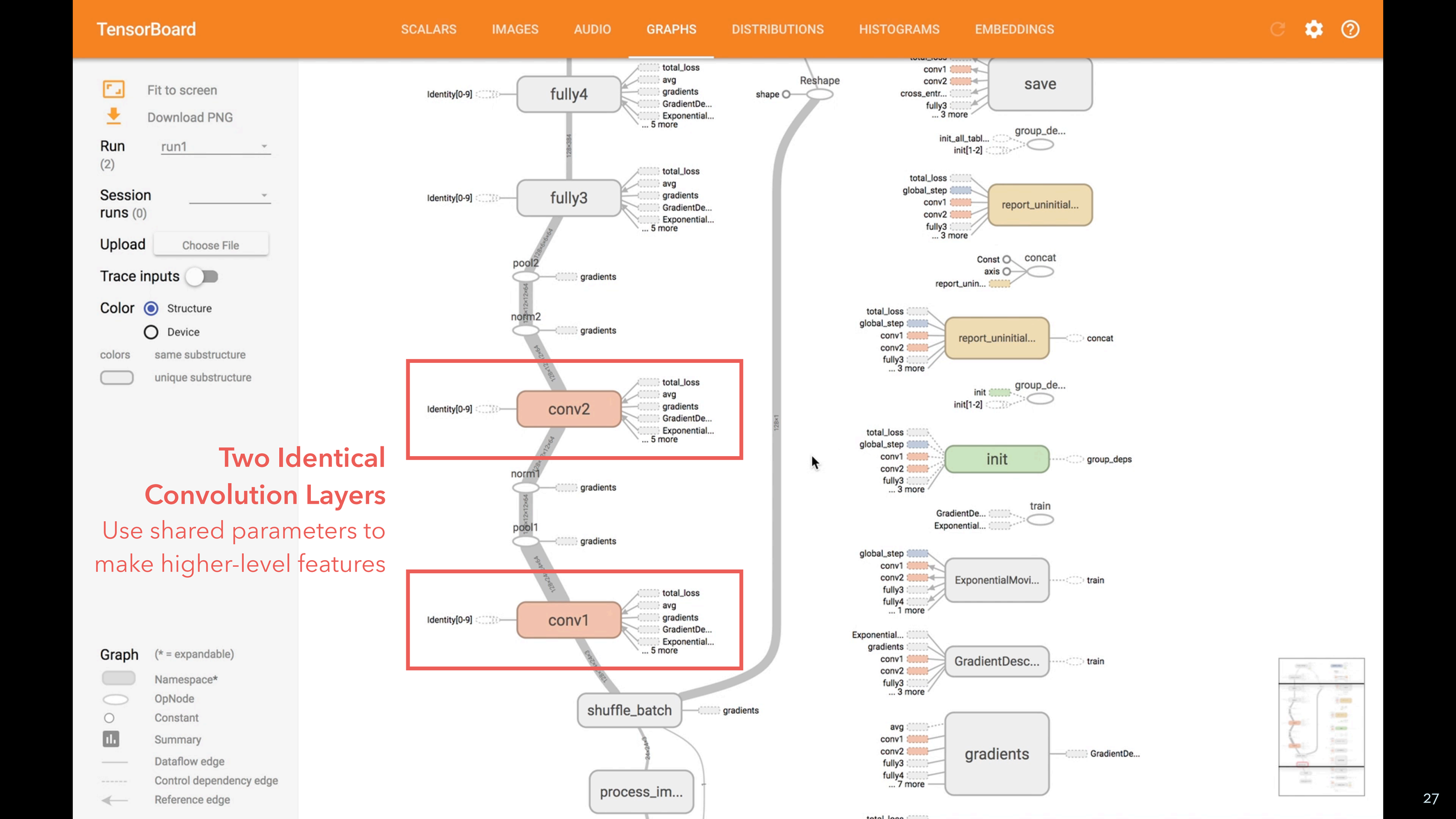
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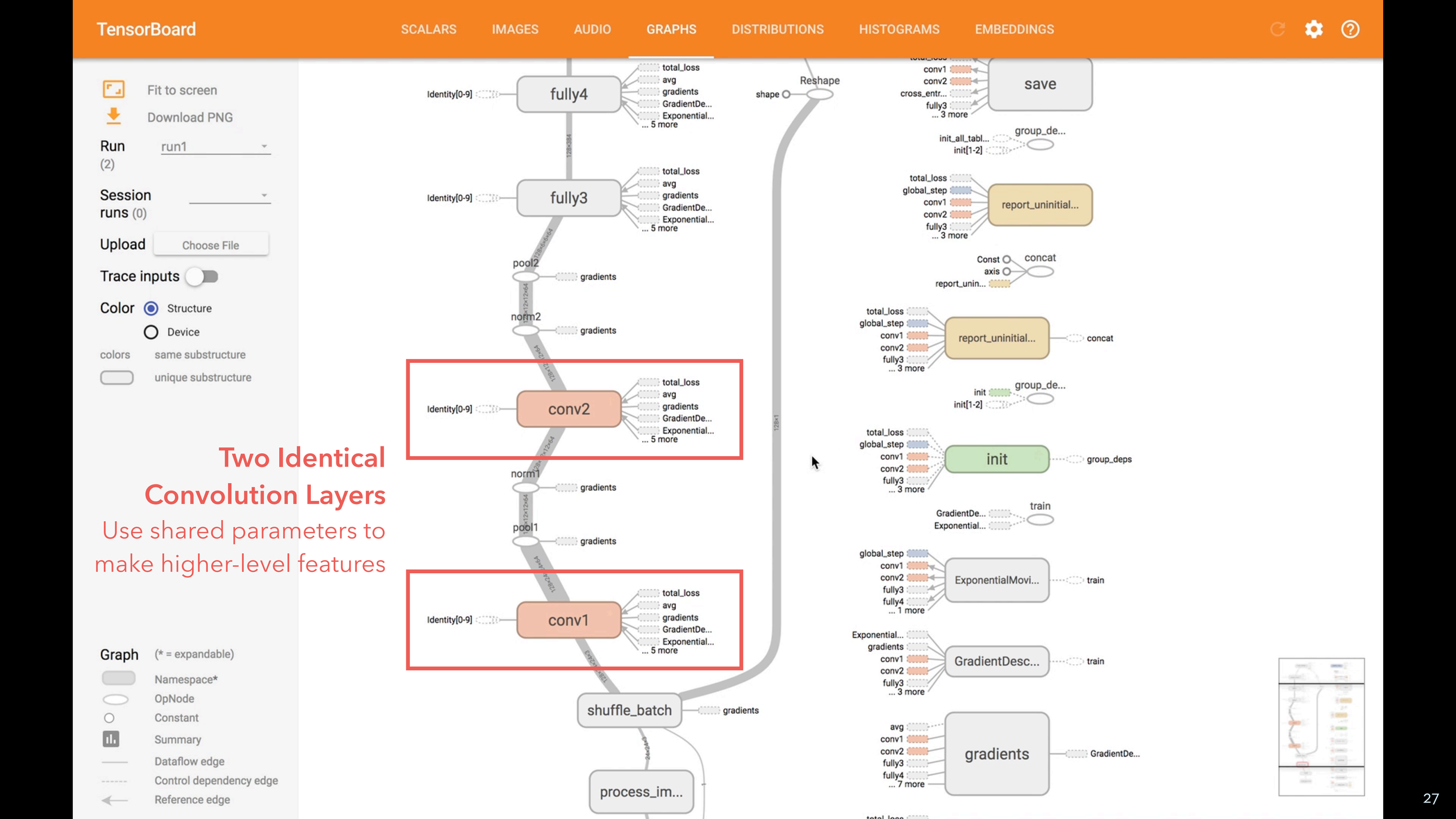
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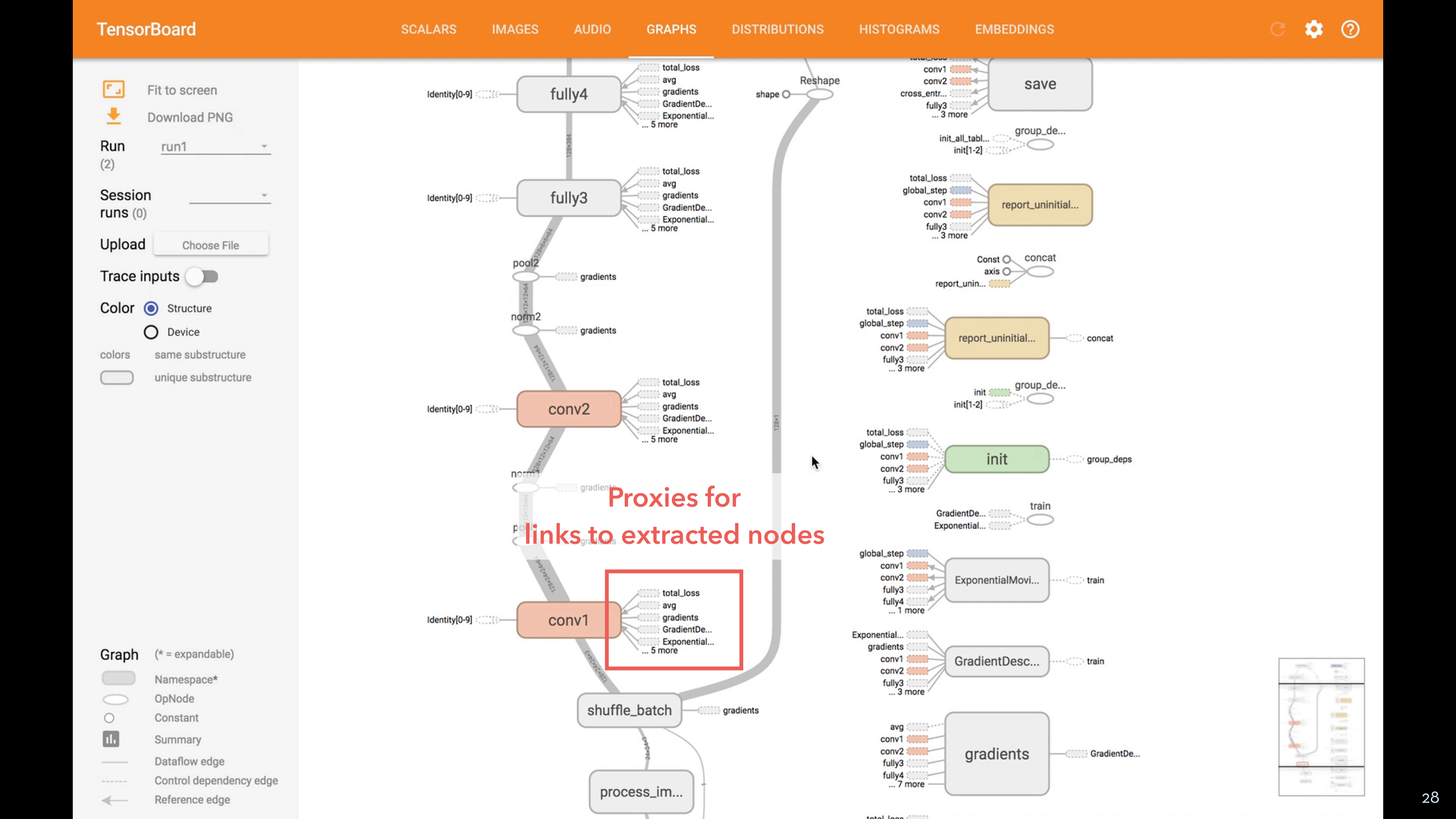
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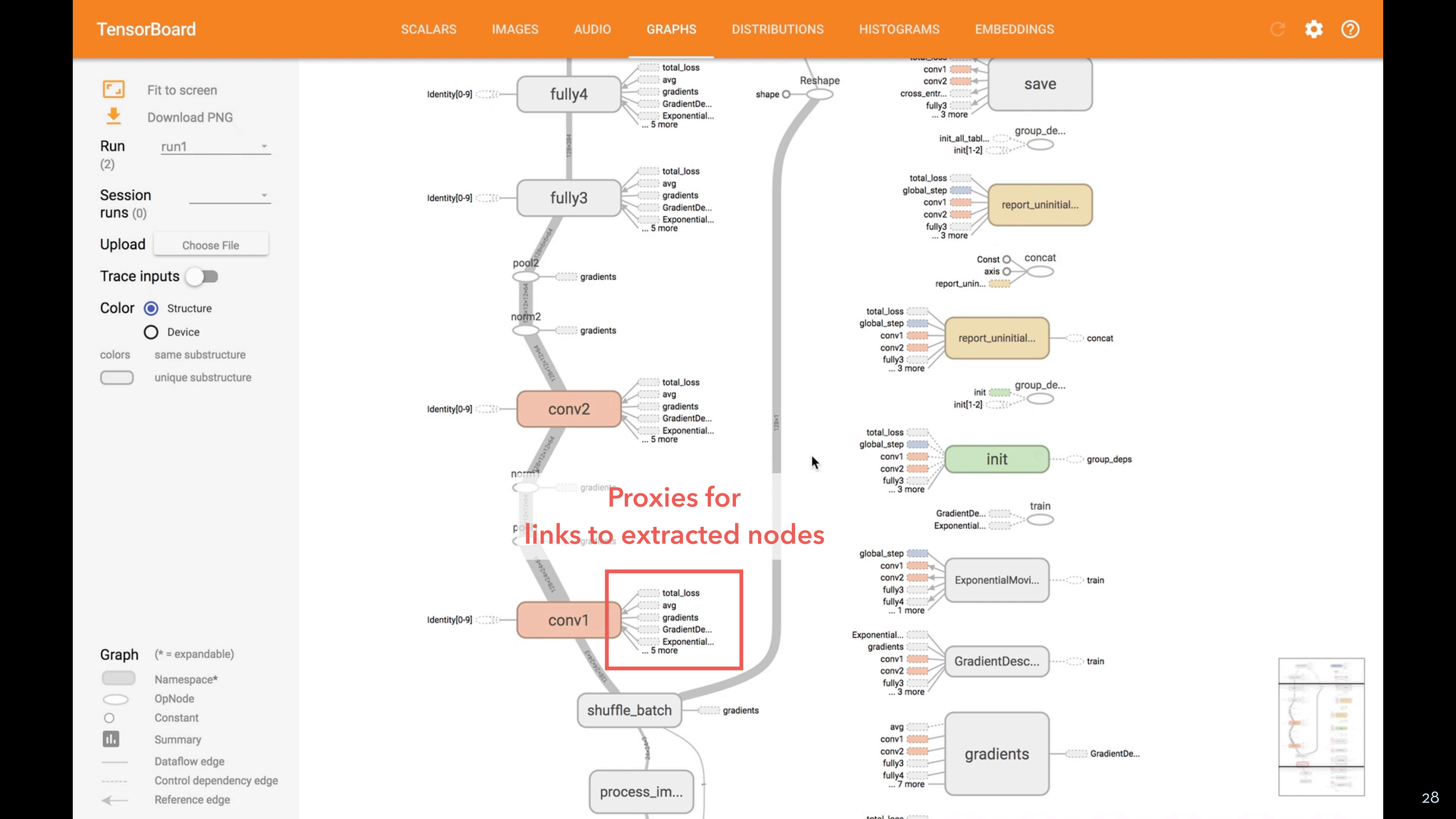
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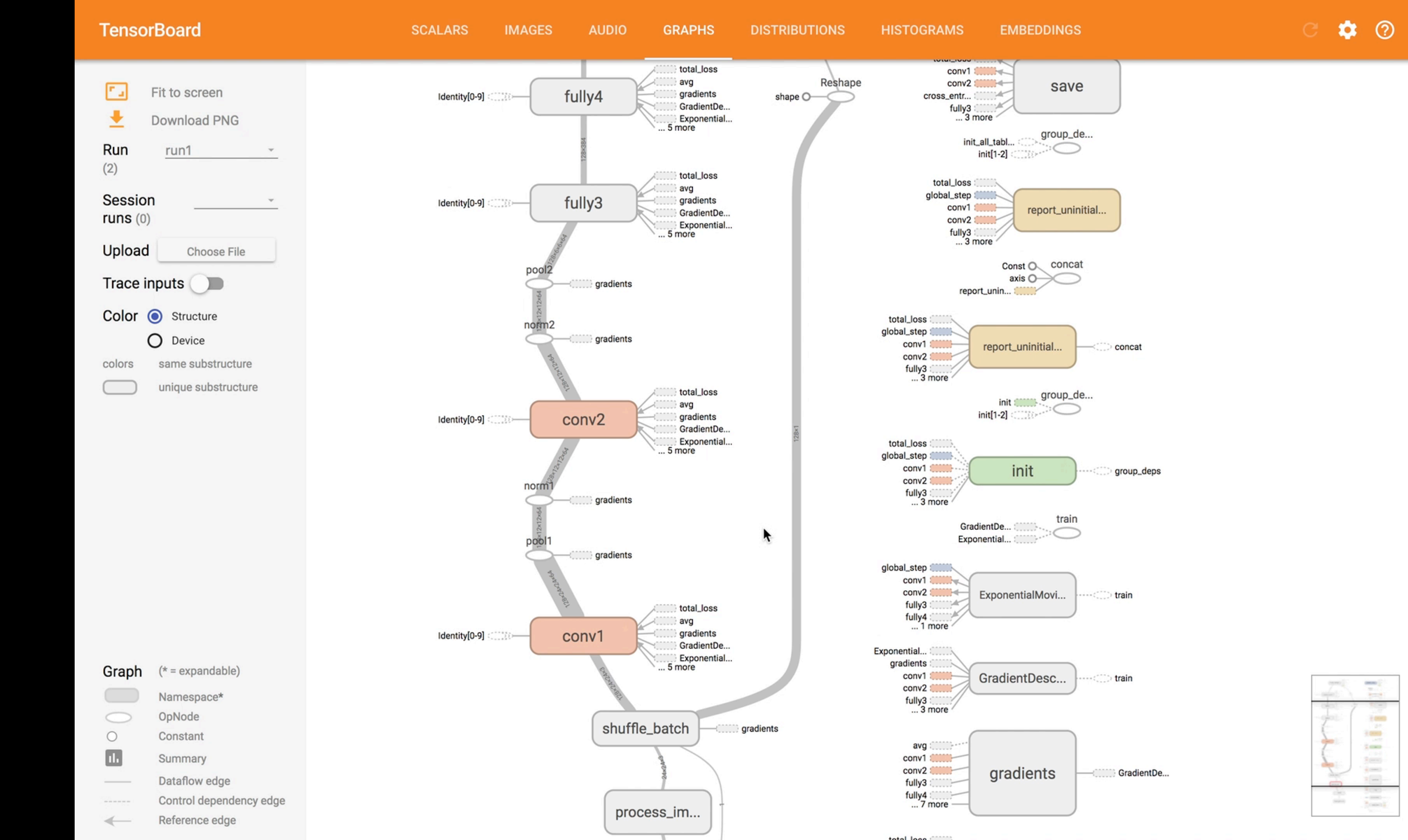
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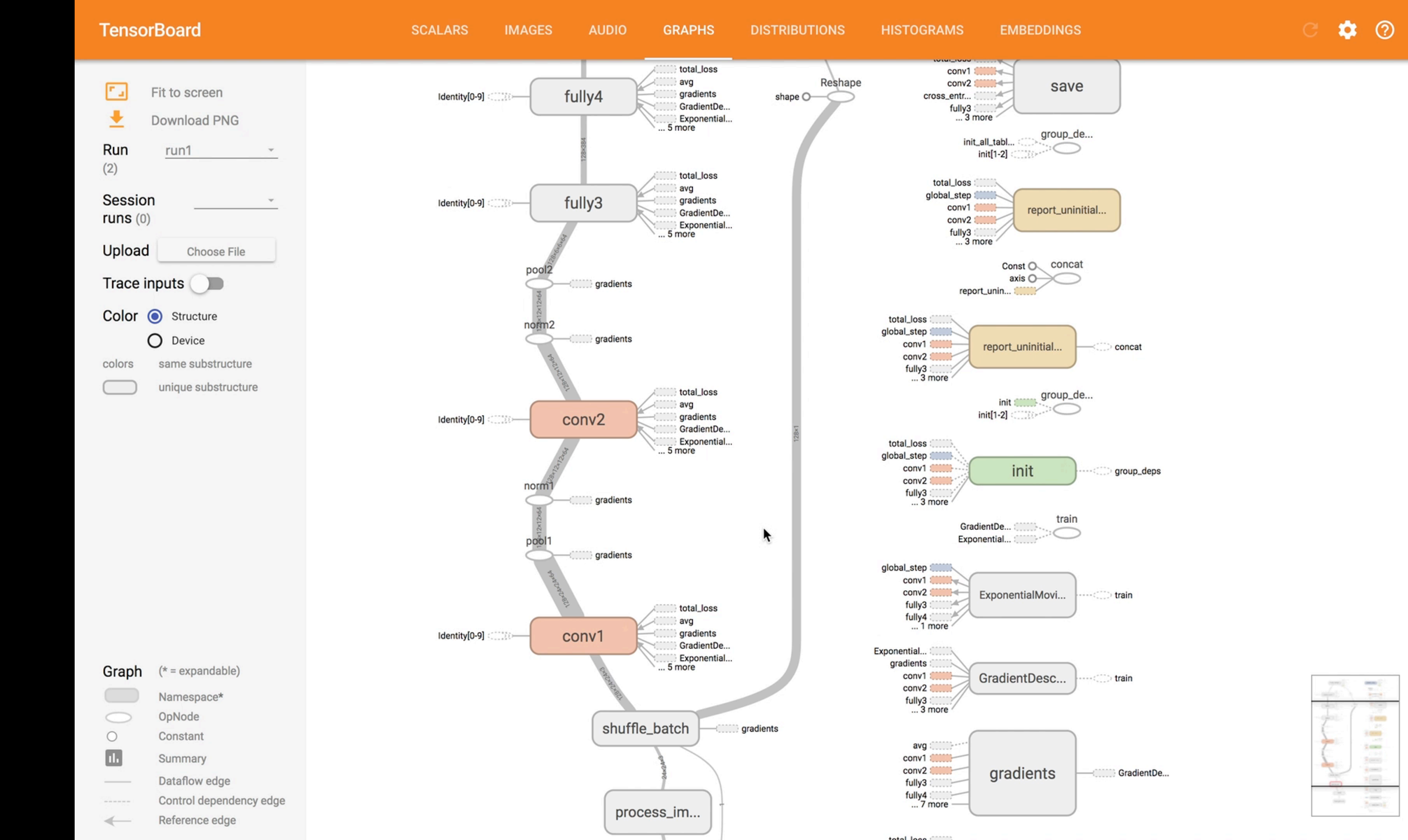
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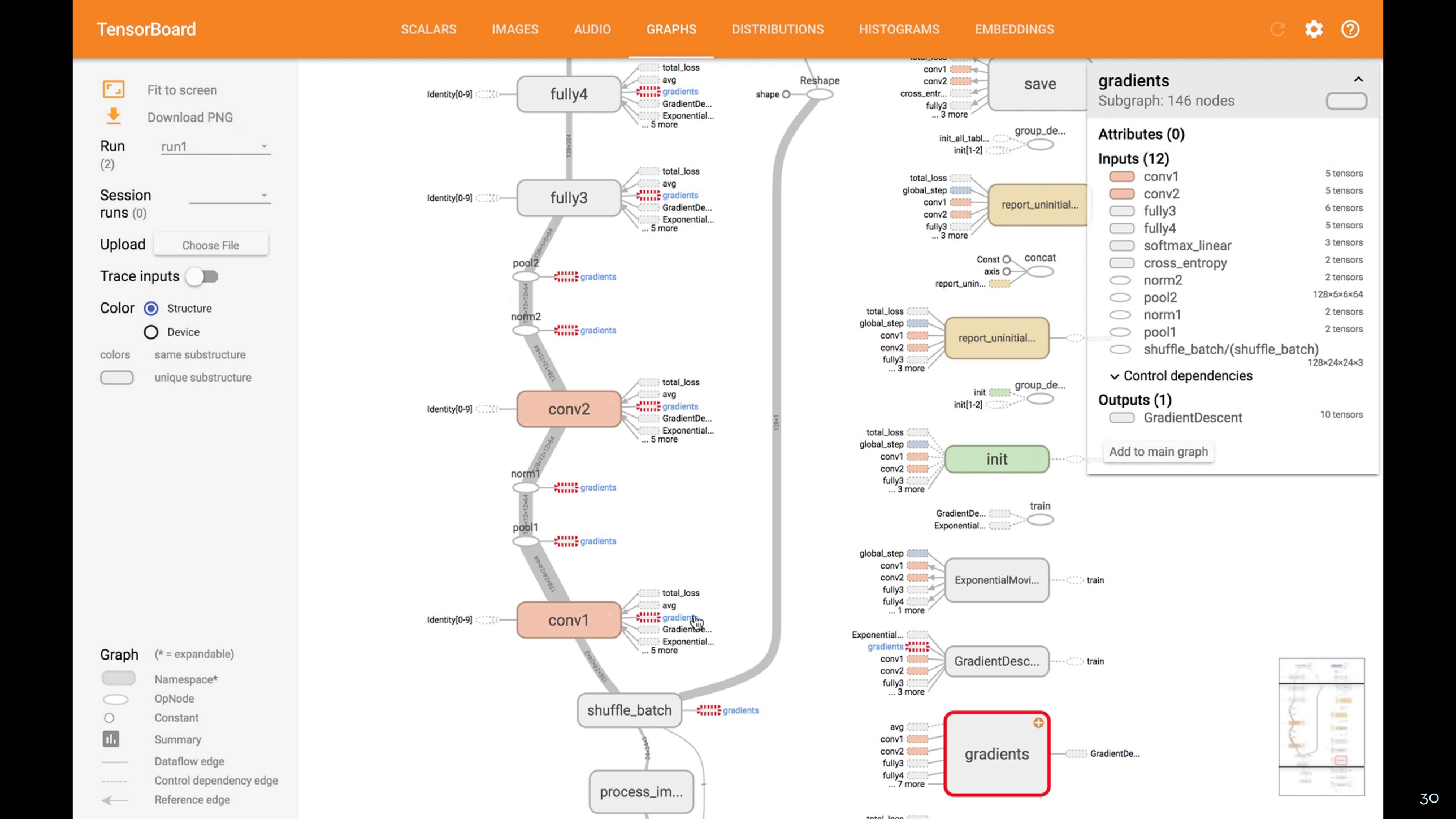
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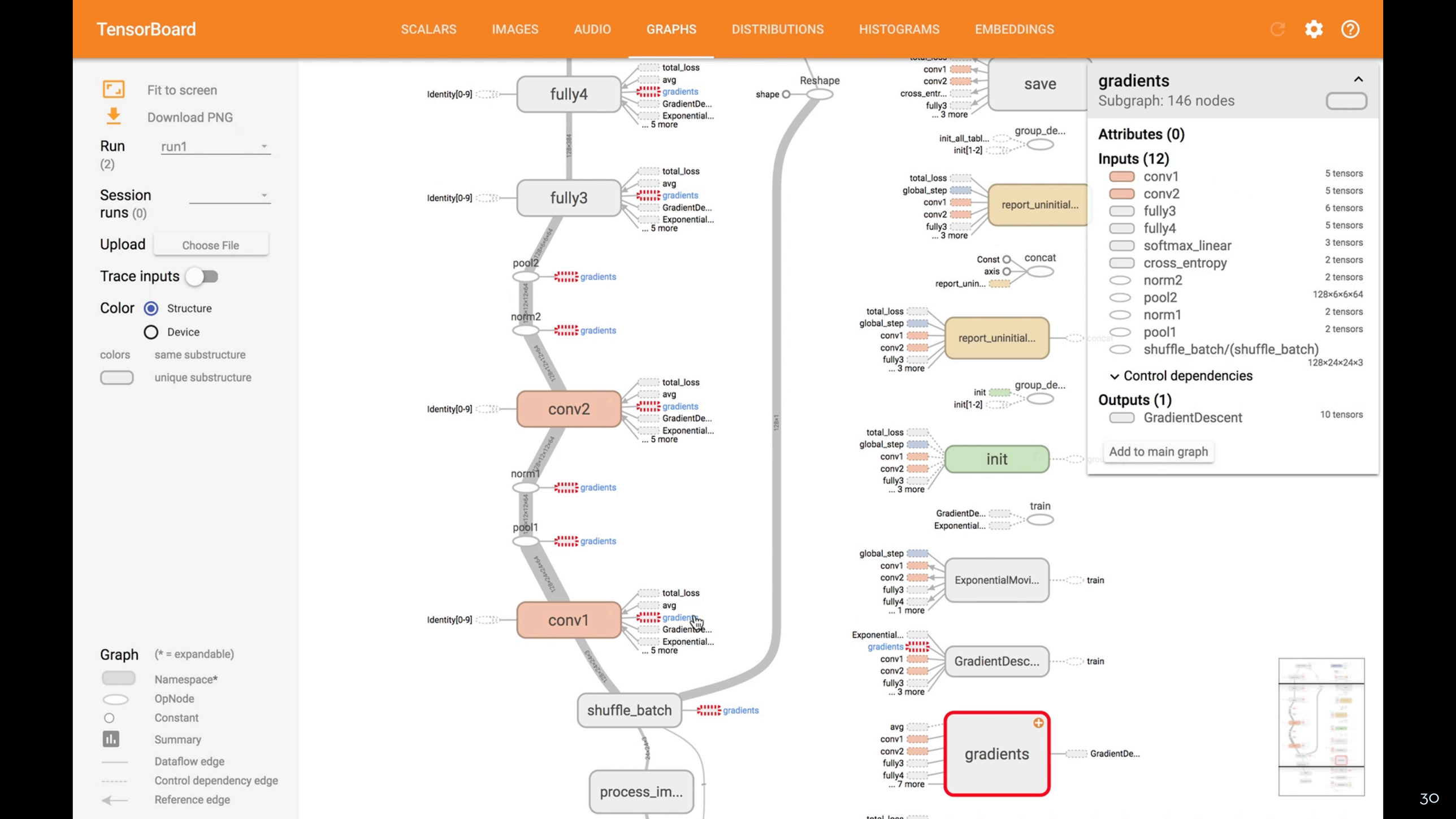
Subgraph: 146 nodes
Attributes (0)
Inputs (12)
conv1 5 tensors
conv2 5 tensors
fully3 6 tensors
fully4 5 tensors
softmax_linear 3 tensors
cross_entropy 2 tensors
norm2 2 tensors
pool2 128×6×6×64
norm1 2 tensors
pool1 2 tensors
shuffle_batch/(shuffle_batch) 128×24×24×3
Control dependencies
Outputs (1)
GradientDescent 10 tensors
Add to main graph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conv2 5 tensors
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fully4 5 tensors
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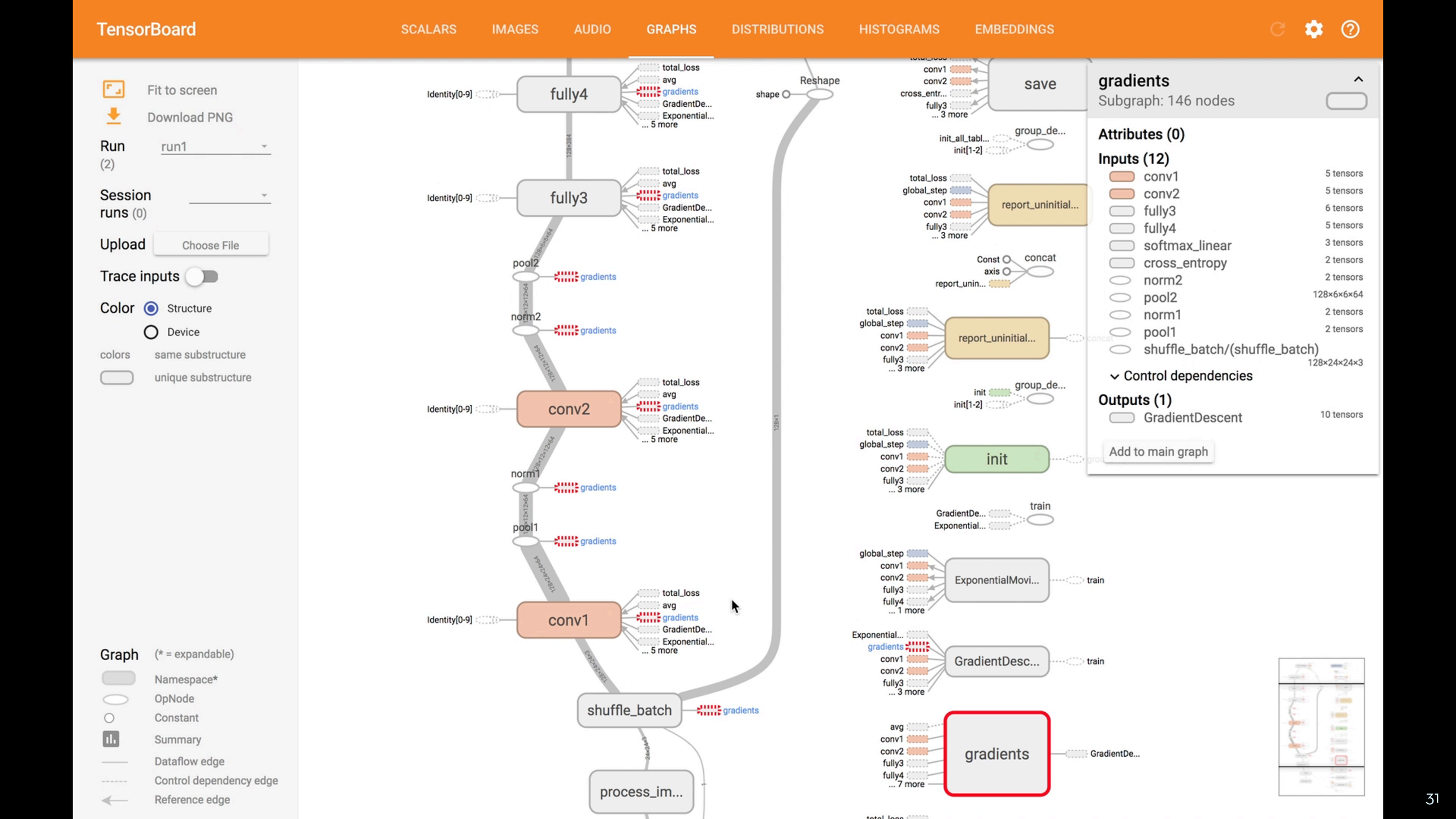
norm1 2 tensors
pool1 2 tensors
shuffle_batch/(shuffle_batch) 128×24×24×3
Control dependencies
Outputs (1)
GradientDescent 10 tensors
Add to main graph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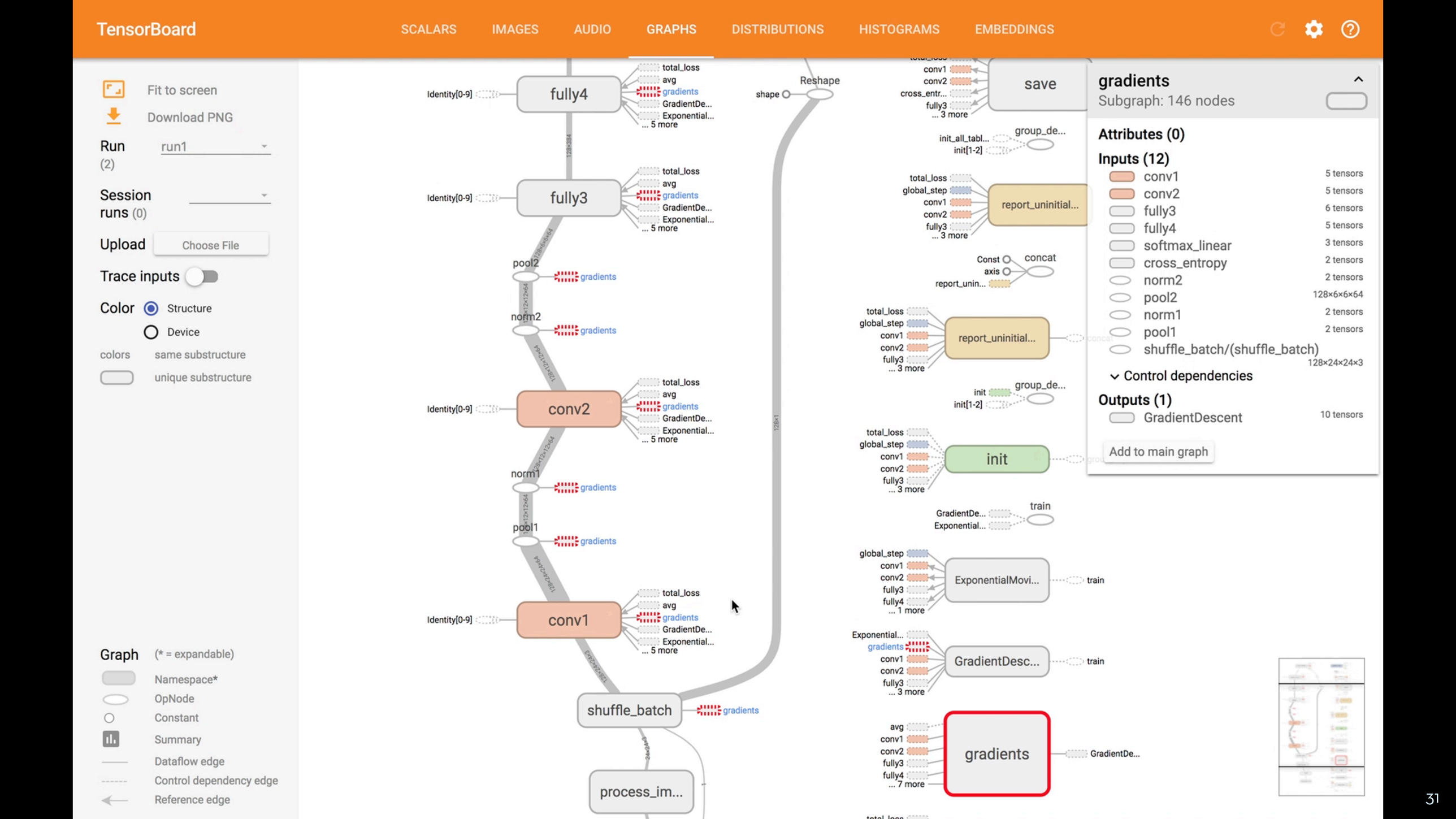
Control dependencies
Outputs (1)
GradientDescent 10 tensors
Add to main graph


TensorBoard
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HISTOGRAMS
EMBEDDINGS
Fit to screen
Download PNG
Run (2)
run1
Session runs (0)
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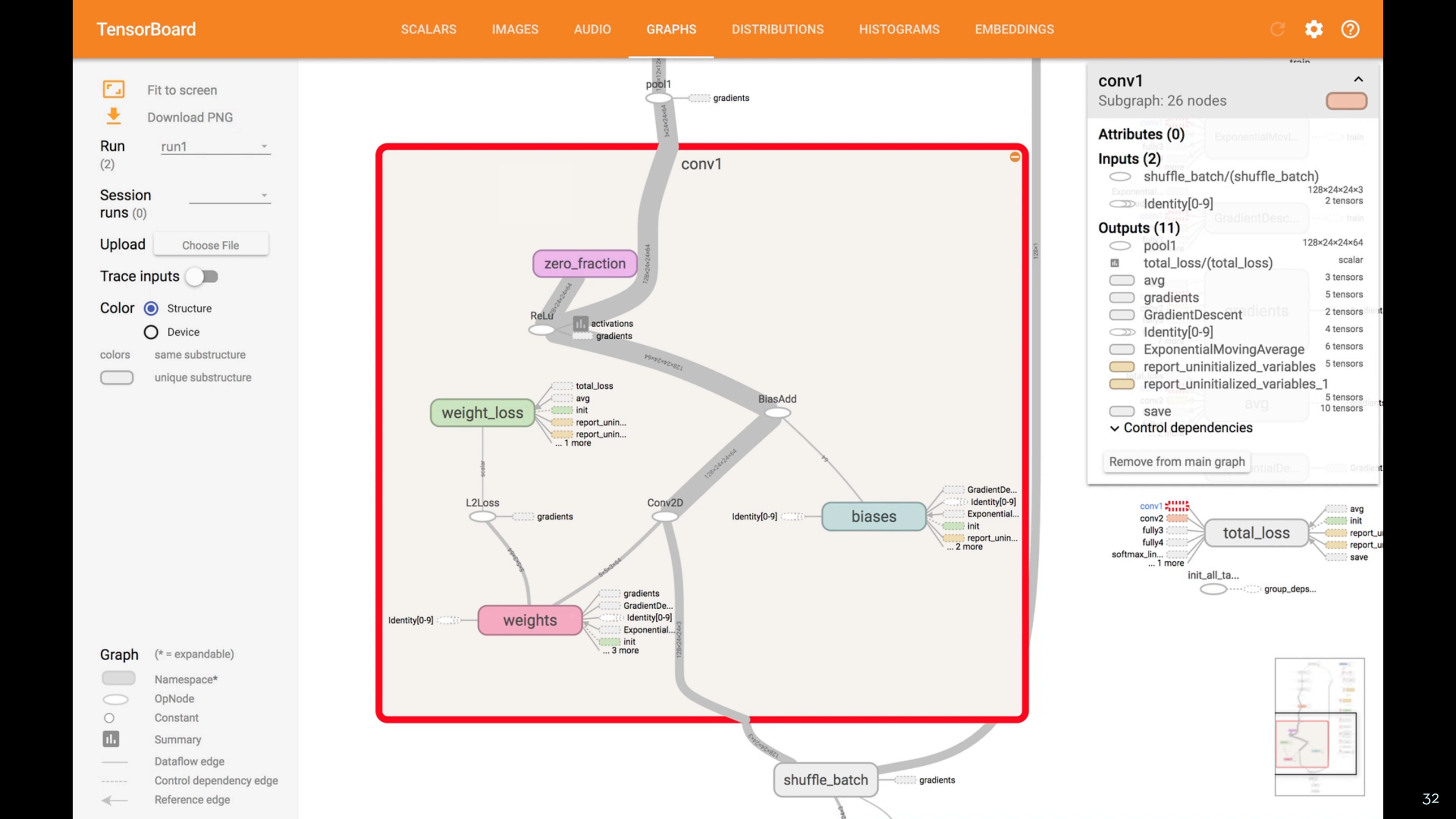
Choose File
Trace inputs
Color
Structure
Device
colors
same substructure
unique substructure
Graph (* = expandable)
Namespace*
OpNode
Constant
Summary
Dataflow edge
Control dependency edge
Reference edge
fully4
fully3
conv2
conv1
pool2
norm2
norm1
pool1
shuffle_batch
process_im...
Identity[0-9]
Reshape
shape
total_loss
avg
gradients
GradientDe...
Exponential...
... 5 more
save
report_uninitial...
concat
Const
axis
init
group_de...
train
ExponentialMovi...
GradientDesc...
gradients
... 7 more
... 3 more
... 1 more
gradients
Subgraph: 146 nodes
Attributes (0)
Inputs (12)
conv1 5 tensors
conv2 5 tensors
fully3 6 tensors
fully4 5 tensors
softmax_linear 3 tensors
cross_entropy 2 tensors
norm2 2 tensors
pool2 128×6×6×64
norm1 2 tensors
pool1 2 tensors
shuffle_batch/(shuffle_batch) 128×24×24×3
Control dependencies
Outputs (1)
GradientDescent 10 tensors
Add to main graph


TensorBoard
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run1
Session runs (0)
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unique substructure
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activations
gradients
BiasAdd
weight_loss
total_loss
avg
init
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report_unin...
... 1 more
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gradients
Conv2D
Identity[0-9]
biases
GradientDe...
Identity[0-9]
Exponential...
init
report_unin...
... 2 more
Identity[0-9]
weights
gradients
GradientDe...
Identity[0-9]
Exponential...
init
... 3 more
shuffle_batch
gradients
conv1
Subgraph: 26 nodes
Attributes (0)
Inputs (2)
shuffle_batch/(shuffle_batch)
128×24×24×3
Identity[0-9]
2 tensors
Outputs (11)
pool1
128×24×24×64
total_loss/(total_loss)
scalar
avg
3 tensors
gradients
5 tensors
GradientDescent
2 tensors
Identity[0-9]
4 tensors
ExponentialMovingAverage
6 tensors
report_uninitialized_variables
5 tensors
report_uninitialized_variables_1
5 tensors
save
10 tensors
Control dependencies
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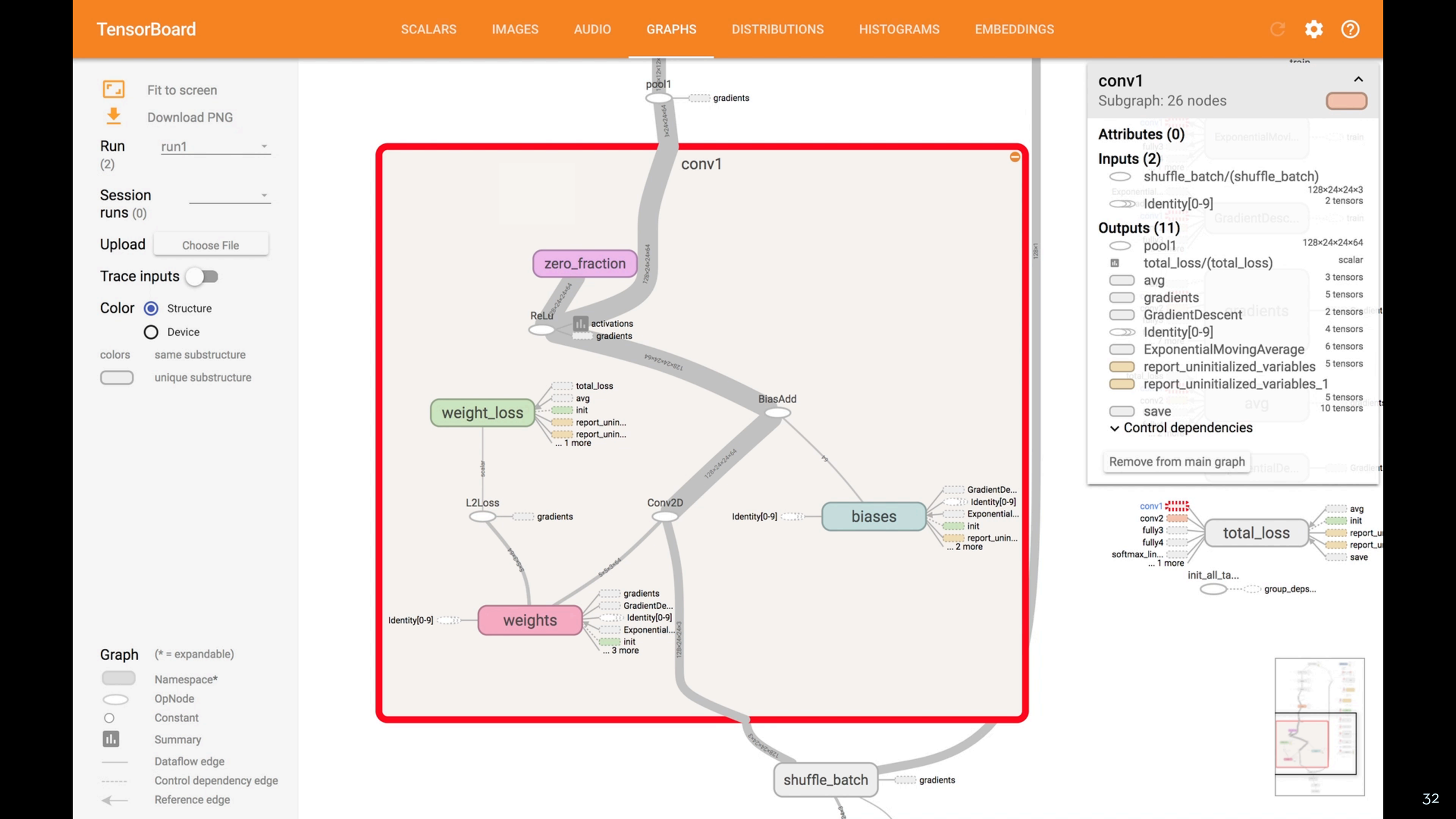
conv1
conv2
fully3
fully4
softmax_lin...
... 1 more
total_loss
avg
init
report_u
report_u
save
init_all_ta...
group_deps...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Session runs (0)
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Structure
Device
colors
same substructure
unique substructure
Graph
(* = expandable)
Namespace*
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BiasAdd
weight_loss
total_loss
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report_unin...
... 1 more
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Identity[0-9]
biases
GradientDe...
Identity[0-9]
Exponential...
init
report_unin...
... 2 more
Identity[0-9]
weights
gradients
GradientDe...
Identity[0-9]
Exponential...
init
... 3 more
shuffle_batch
gradients
conv1
Subgraph: 26 nodes
Attributes (0)
Inputs (2)
shuffle_batch/(shuffle_batch)
128×24×24×3
Identity[0-9]
2 tensors
Outputs (11)
pool1
128×24×24×64
total_loss/(total_loss)
scalar
avg
3 tensors
gradients
5 tensors
GradientDescent
2 tensors
Identity[0-9]
4 tensors
ExponentialMovingAverage
6 tensors
report_uninitialized_variables
5 tensors
report_uninitialized_variables_1
5 tensors
save
10 tensors
Control dependencies
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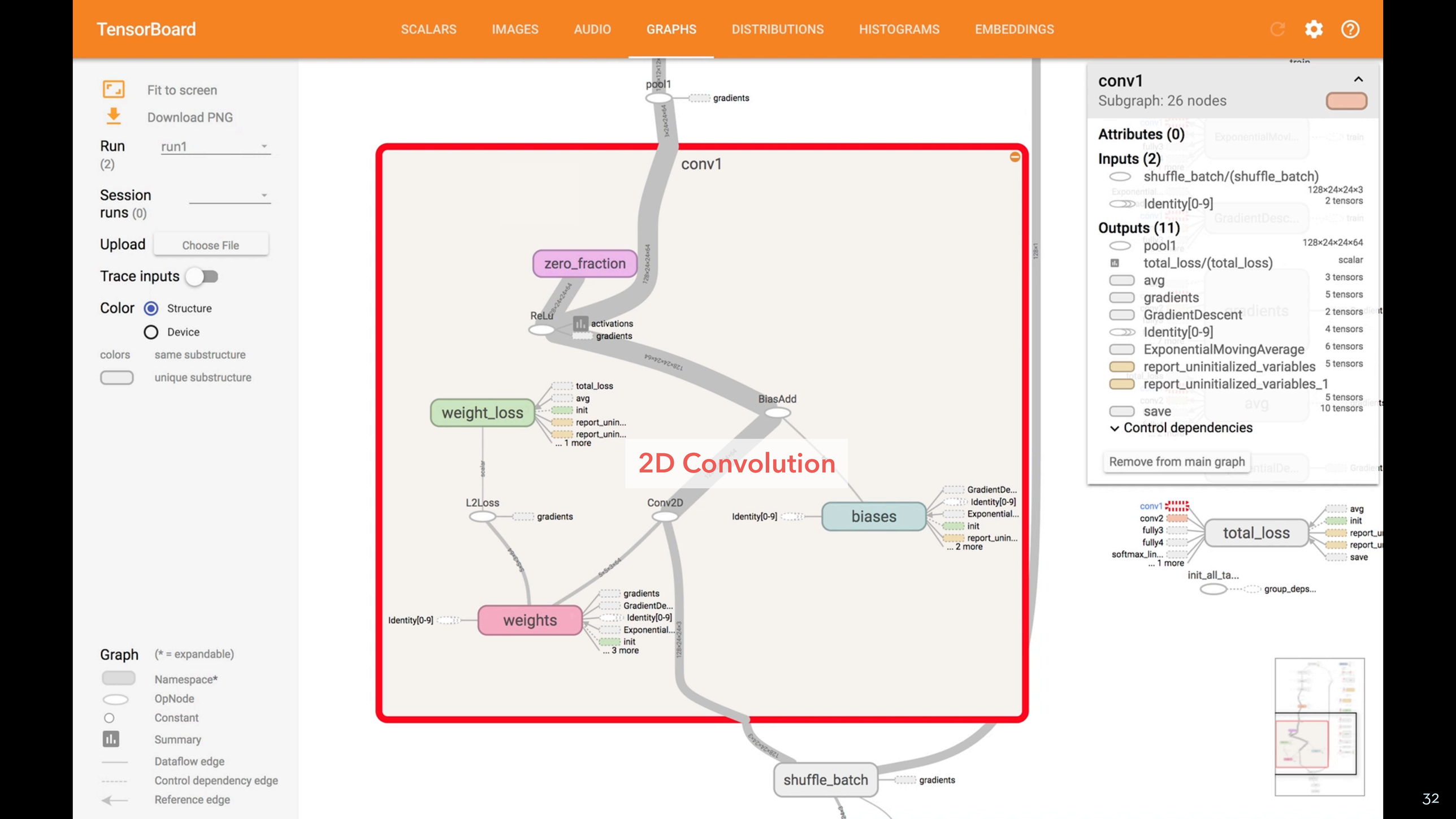
conv2
fully3
fully4
softmax_lin...
... 1 more
total_loss
avg
init
report_u
report_u
save
init_all_ta...
group_deps...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BiasAdd
weight_loss
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report_unin...
... 1 more
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Conv2D
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biases
GradientDe...
Identity[0-9]
Exponential...
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report_unin...
... 2 more
Identity[0-9]
weights
gradients
GradientDe...
Identity[0-9]
Exponential...
init
... 3 more
shuffle_batch
gradients
conv1
Subgraph: 26 nodes
Attributes (0)
Inputs (2)
shuffle_batch/(shuffle_batch)
128×24×24×3
Identity[0-9]
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Outputs (11)
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128×24×24×64
total_loss/(total_loss)
scalar
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3 tensors
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5 tensors
GradientDescent
2 tensors
Identity[0-9]
4 tensors
ExponentialMovingAverage
6 tensors
report_uninitialized_variables
5 tensors
report_uninitialized_variables_1
5 tensors
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10 tensors
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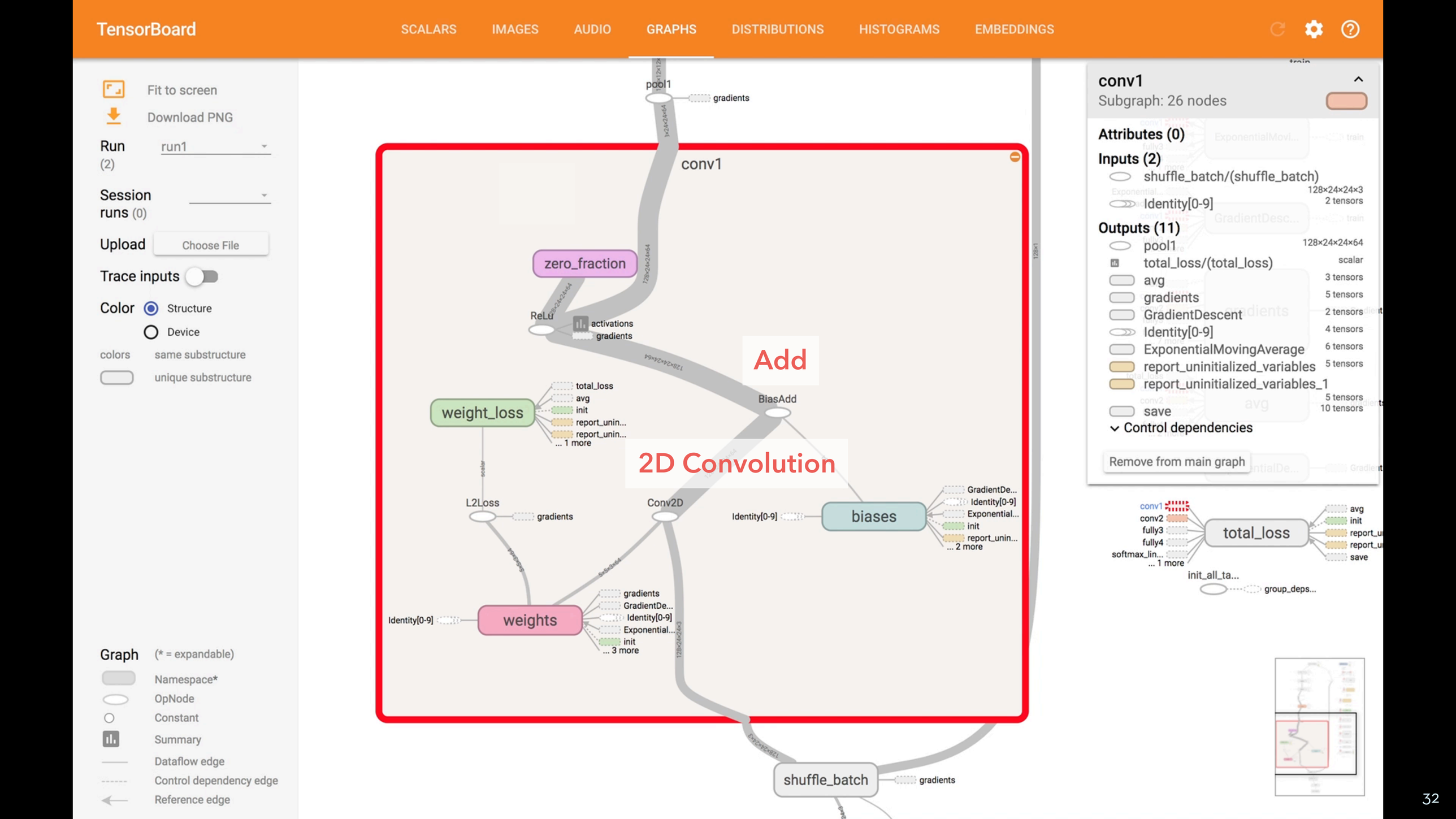
conv2
fully3
fully4
softmax_lin...
... 1 more
total_loss
avg
init
report_u
report_u
save
init_all_ta...
group_deps...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Session runs (0)
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report_unin...
... 1 more
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Conv2D
Identity[0-9]
biases
GradientDe...
Identity[0-9]
Exponential...
init
report_unin...
... 2 more
Identity[0-9]
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GradientDe...
Identity[0-9]
Exponential...
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... 3 more
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128×24×24×3
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fully4
softmax_lin...
... 1 more
total_loss
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init
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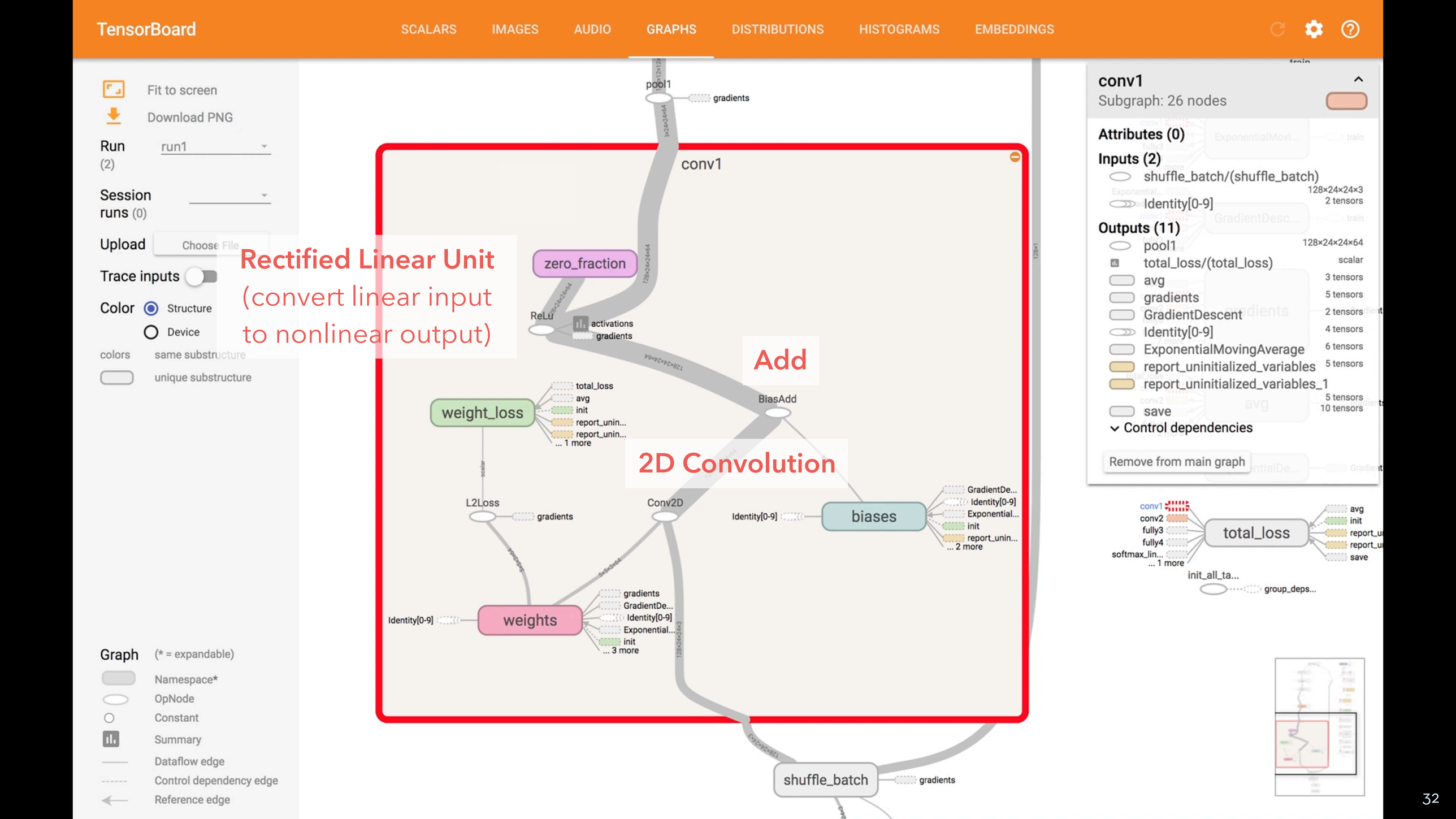
report_u
save
init_all_ta...
group_deps...


TensorBoard
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Run (2)
run1
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unique substructure
Rectified Linear Unit
(convert linear input
to nonlinear output)
Add
2D Convolution
pool1
gradients
conv1
zero_fraction
ReLu
activations
gradients
BiasAdd
weight_loss
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report_unin...
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Conv2D
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Identity[0-9]
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Identity[0-9]
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gradients
GradientDe...
Identity[0-9]
Exponential...
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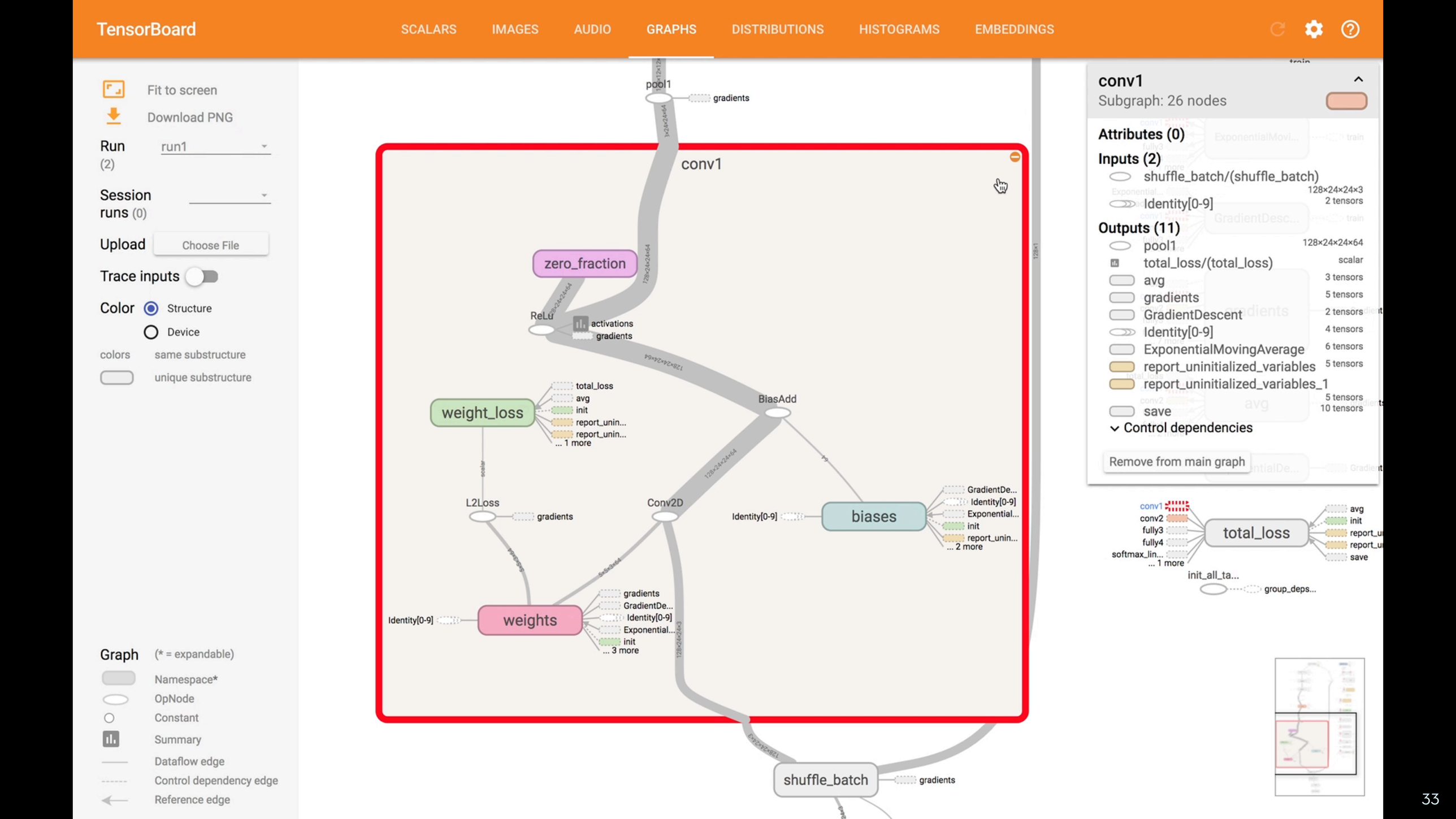
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softmax_lin...
... 1 more
total_loss
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report_u
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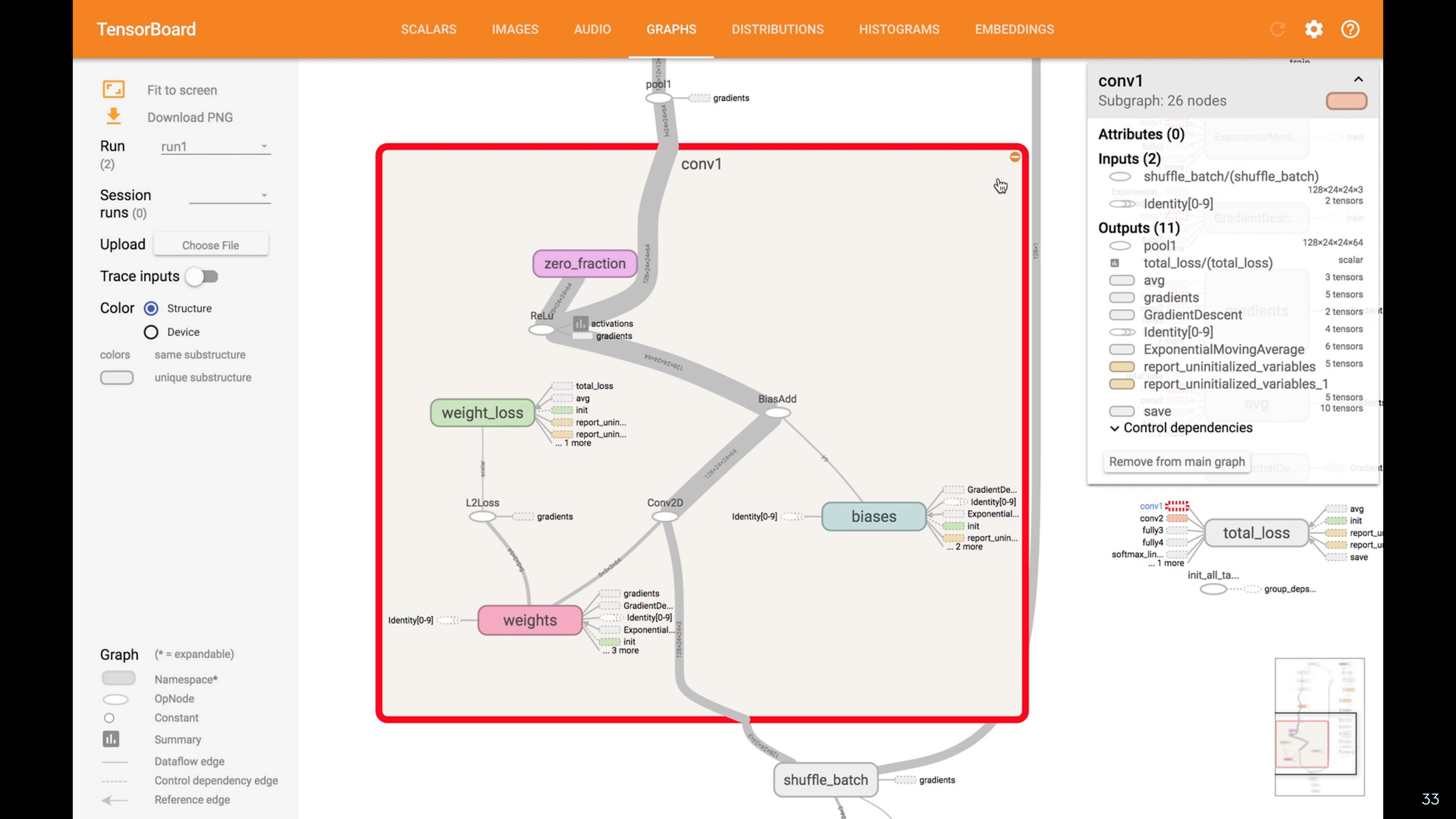
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Attributes (0)
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shuffle_batch/(shuffle_batch)
128×24×24×3
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fully4
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... 1 more
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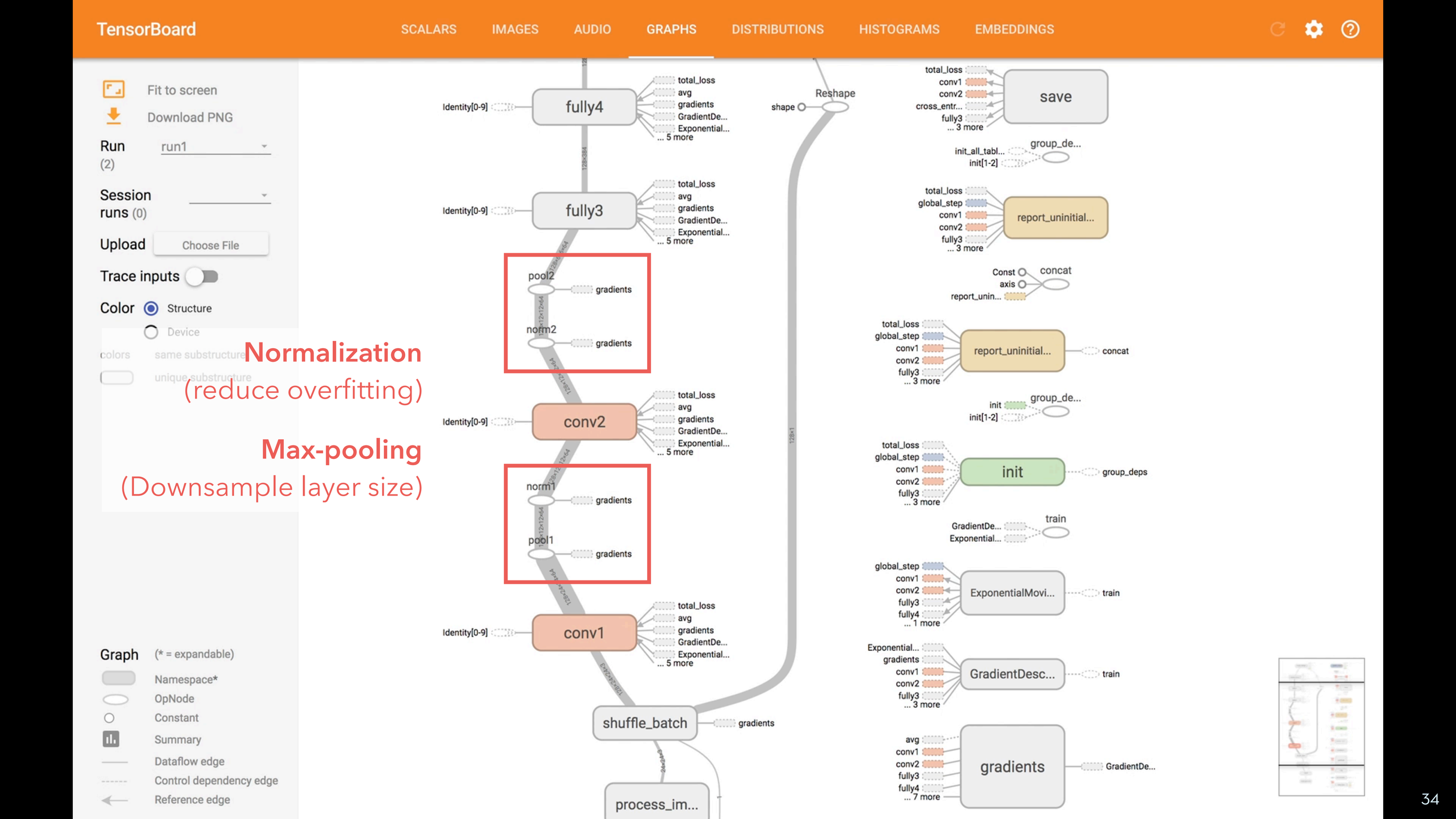
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Max-pooling
(Downsample layer size)
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Identity[0-9]
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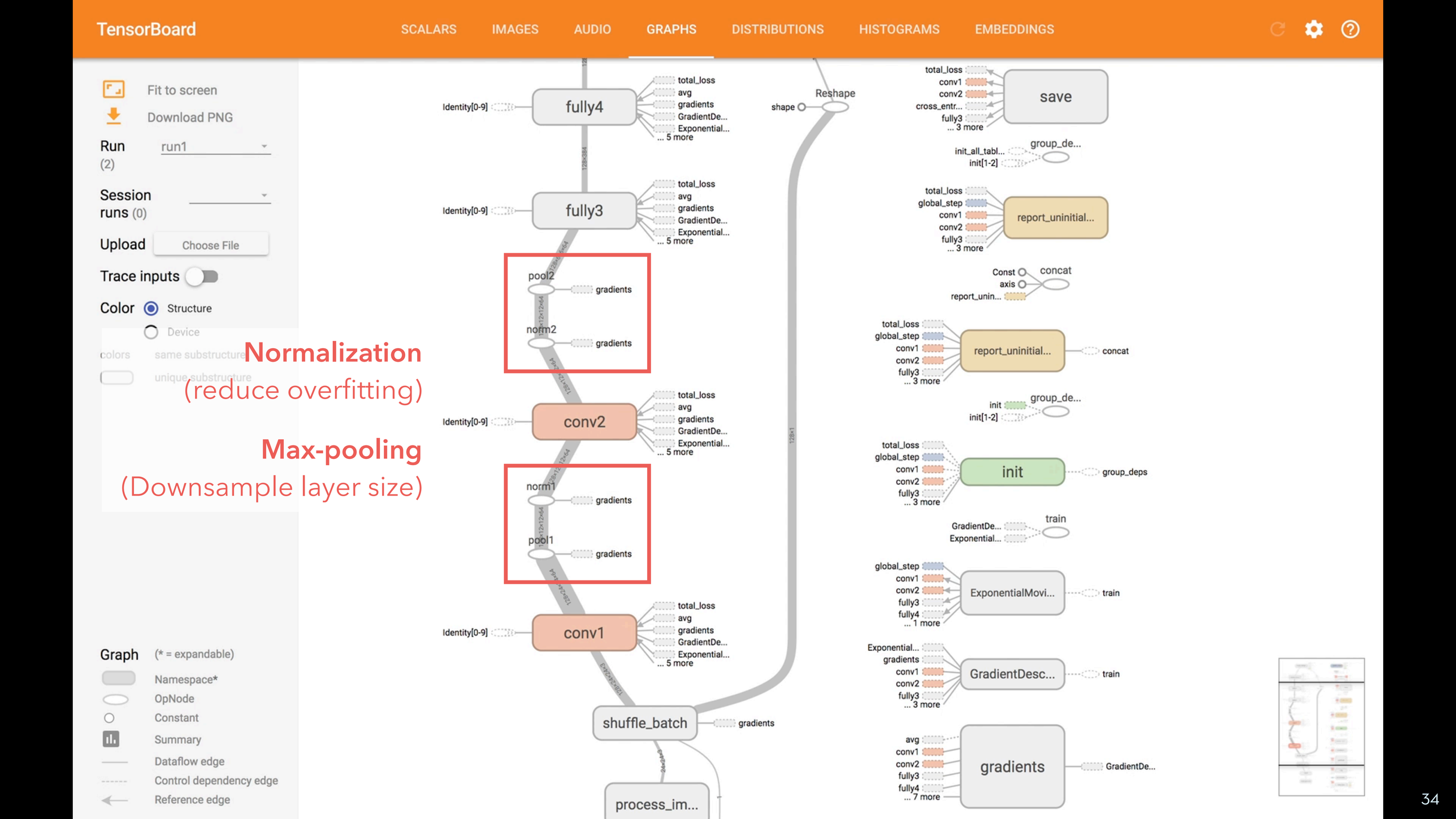
ExponentialMovi...
GradientDesc...
global_step
conv1
conv2
fully3
fully4
... 3 more
... 1 more
... 7 more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ExponentialMovi...
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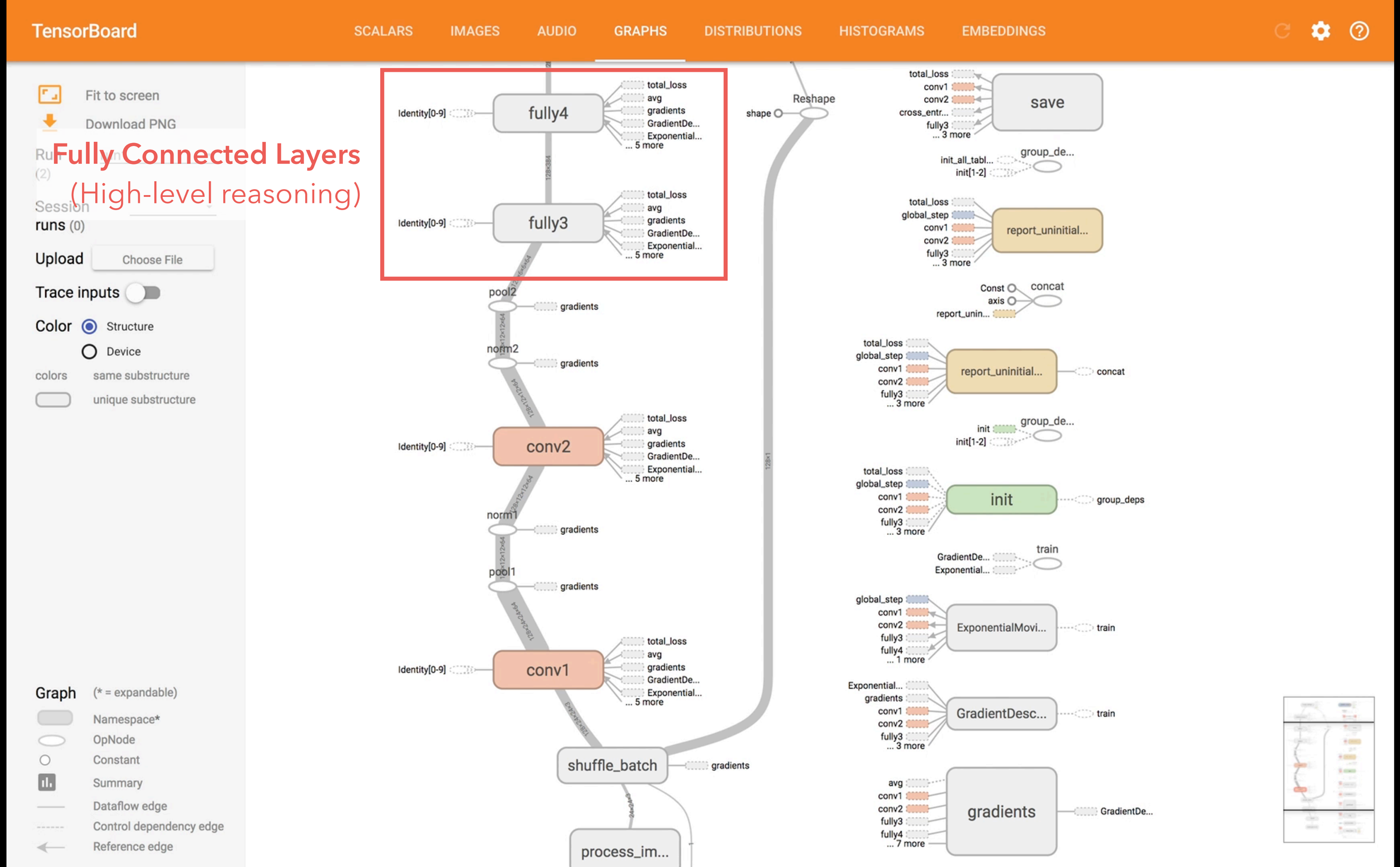
... 1 more
... 7 more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Fully Connected Layers
(High-level reasoning)
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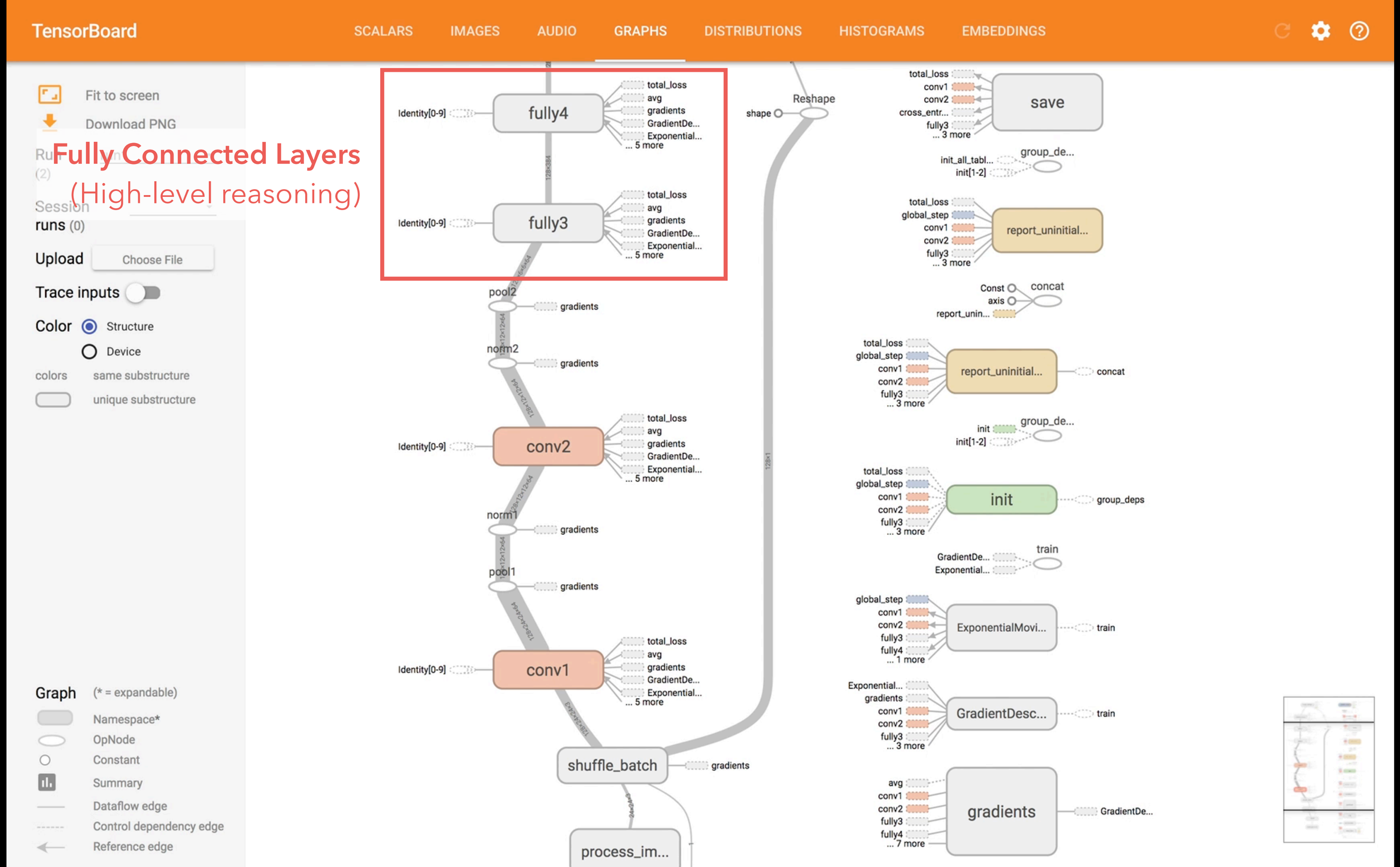
... 7 more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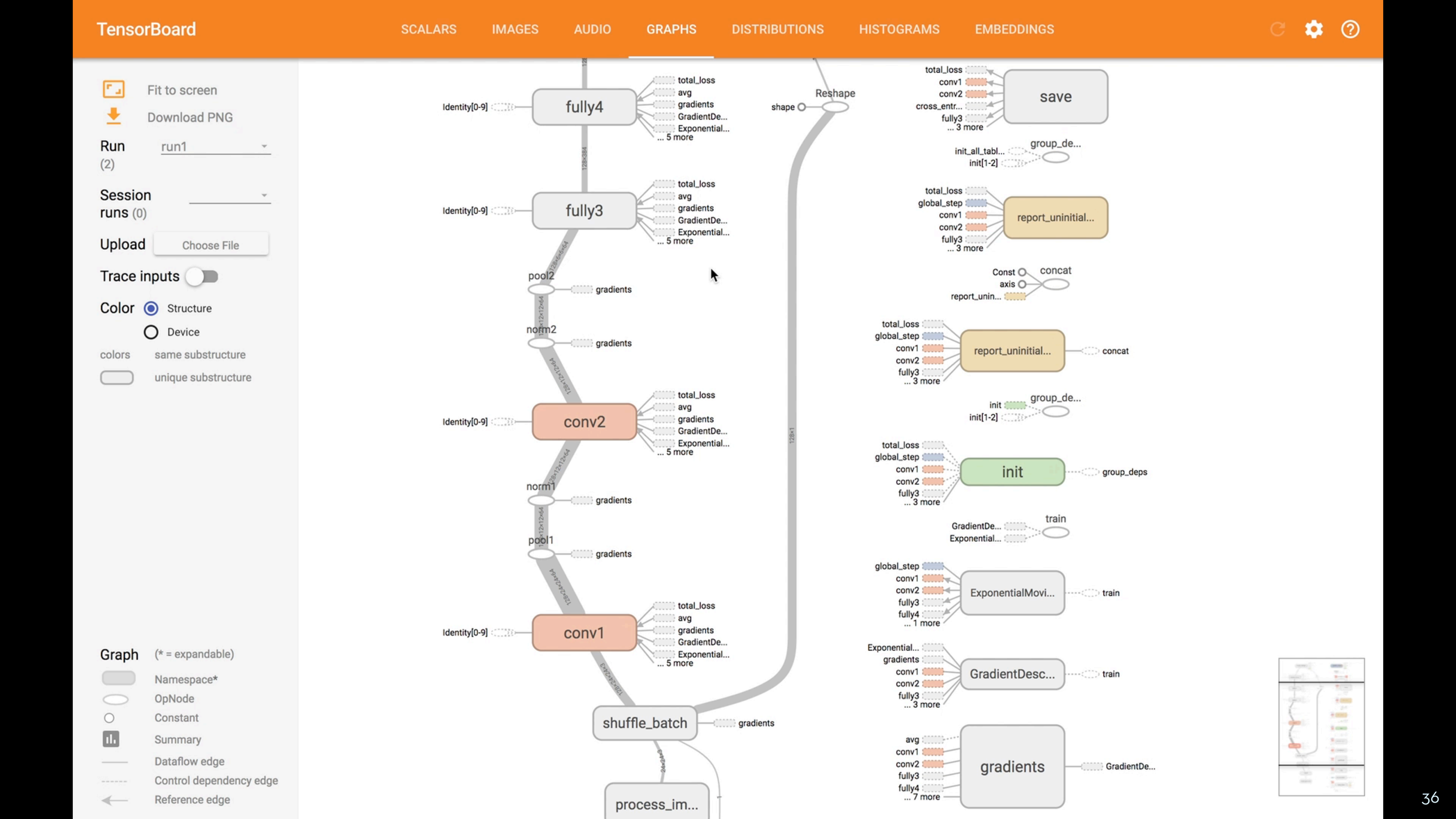
... 7 more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ExponentialMovi...
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... 3 more
... 1 more
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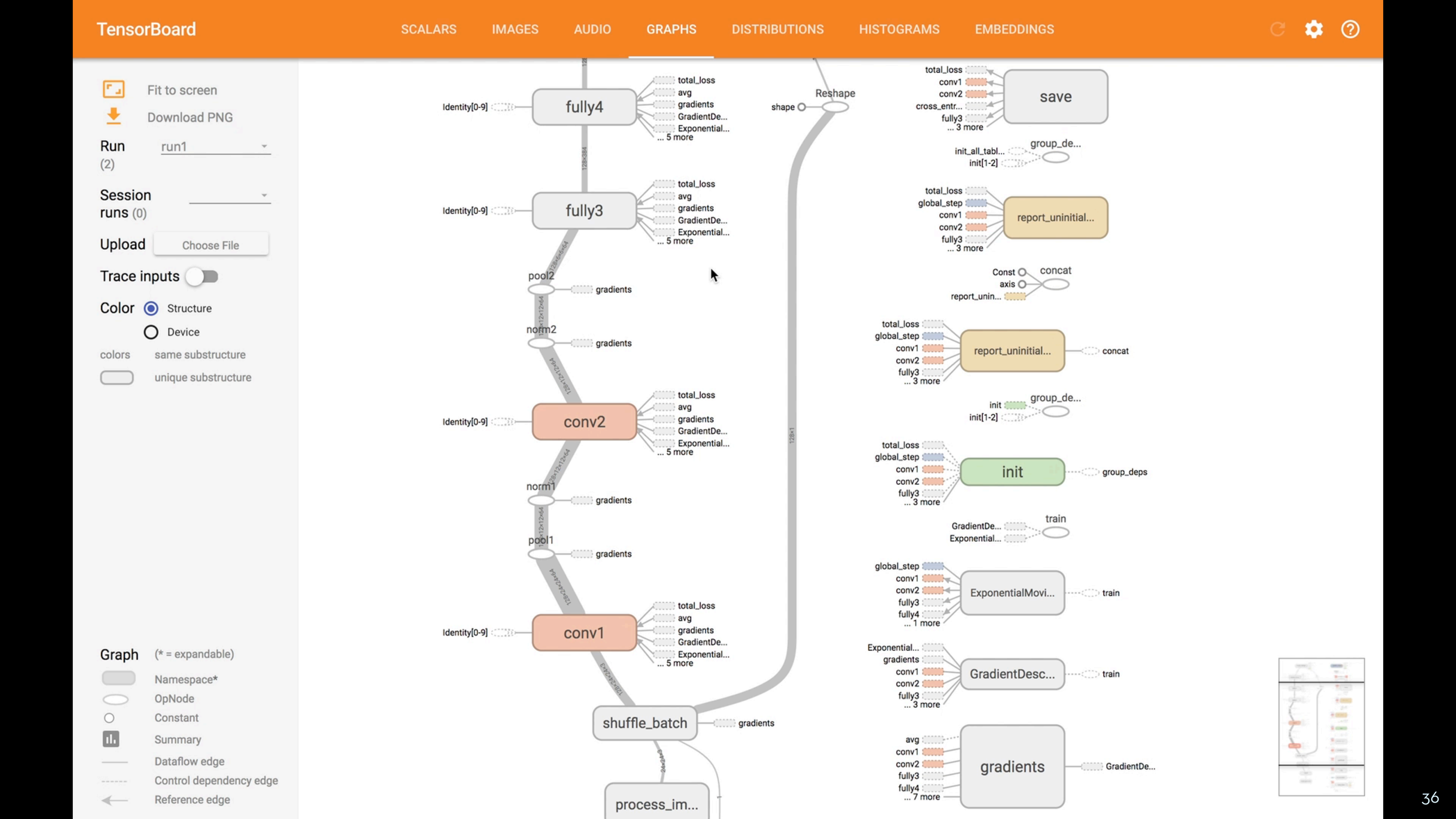
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Const
axis
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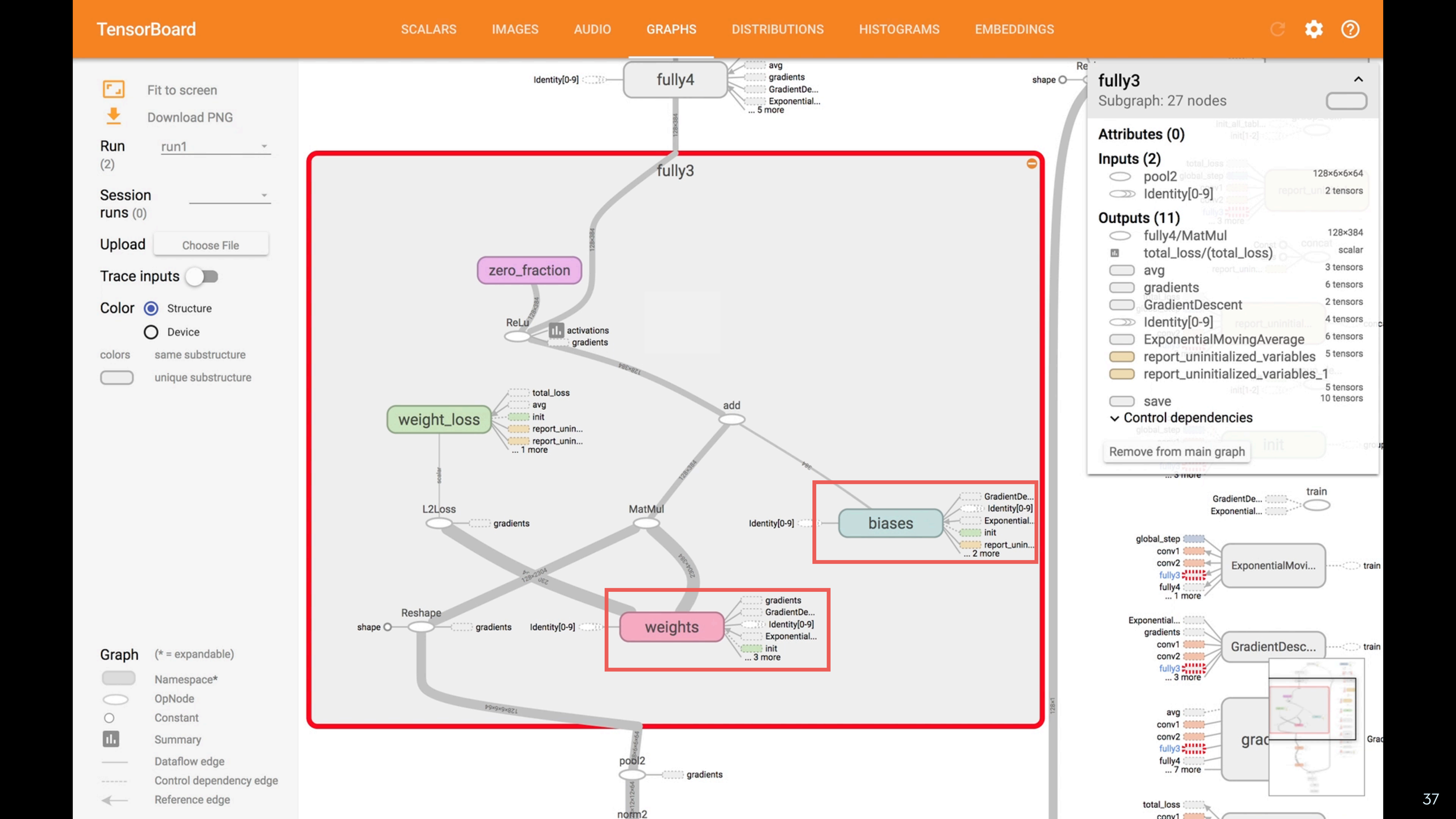
... 3 more
... 1 more
... 7 more


TensorBoard
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total_loss
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weights
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GradientDe...
Identity[0-9]
Exponential...
init
... 3 more
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norm2
shape
fully3
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... 7 more
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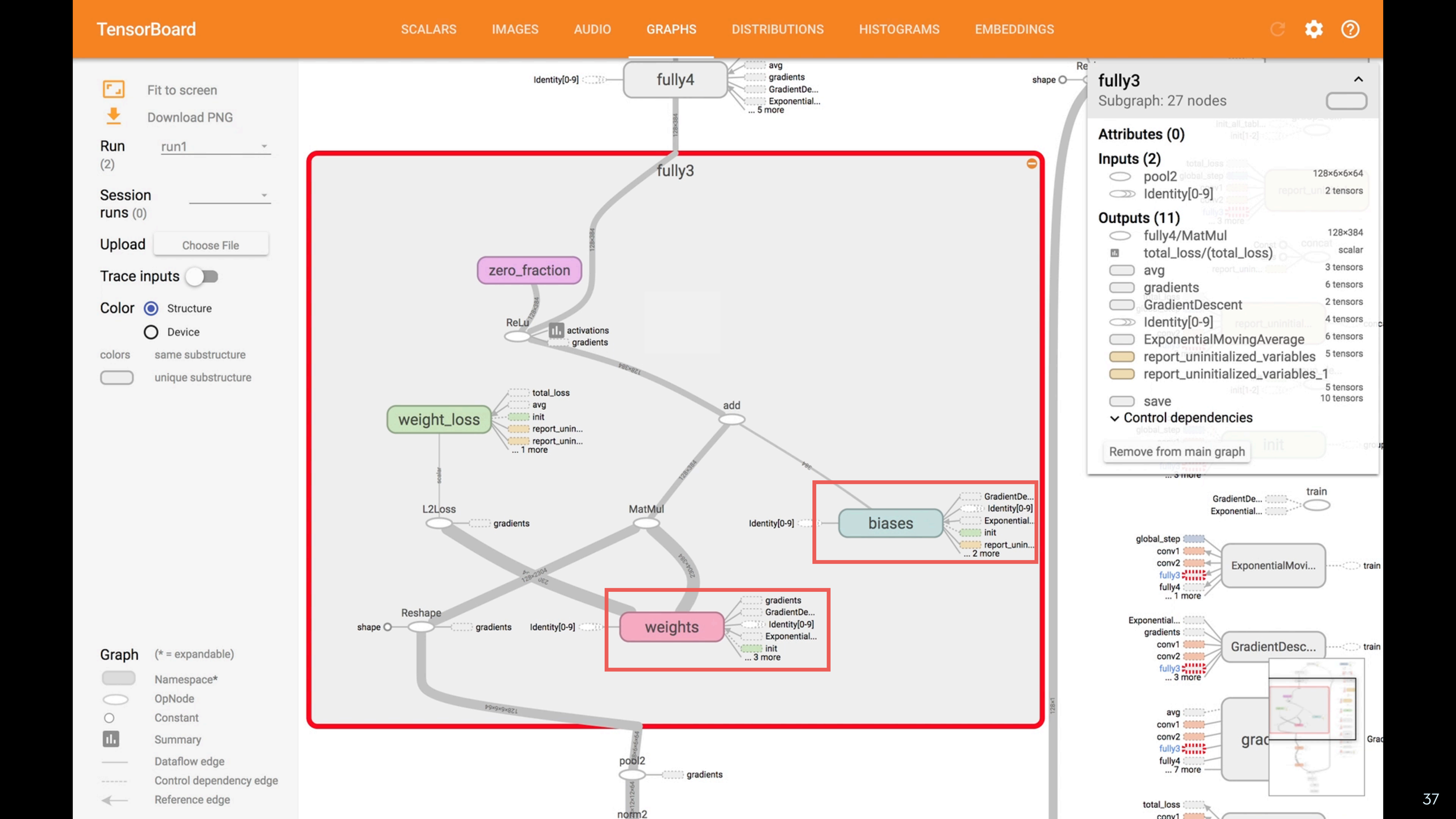
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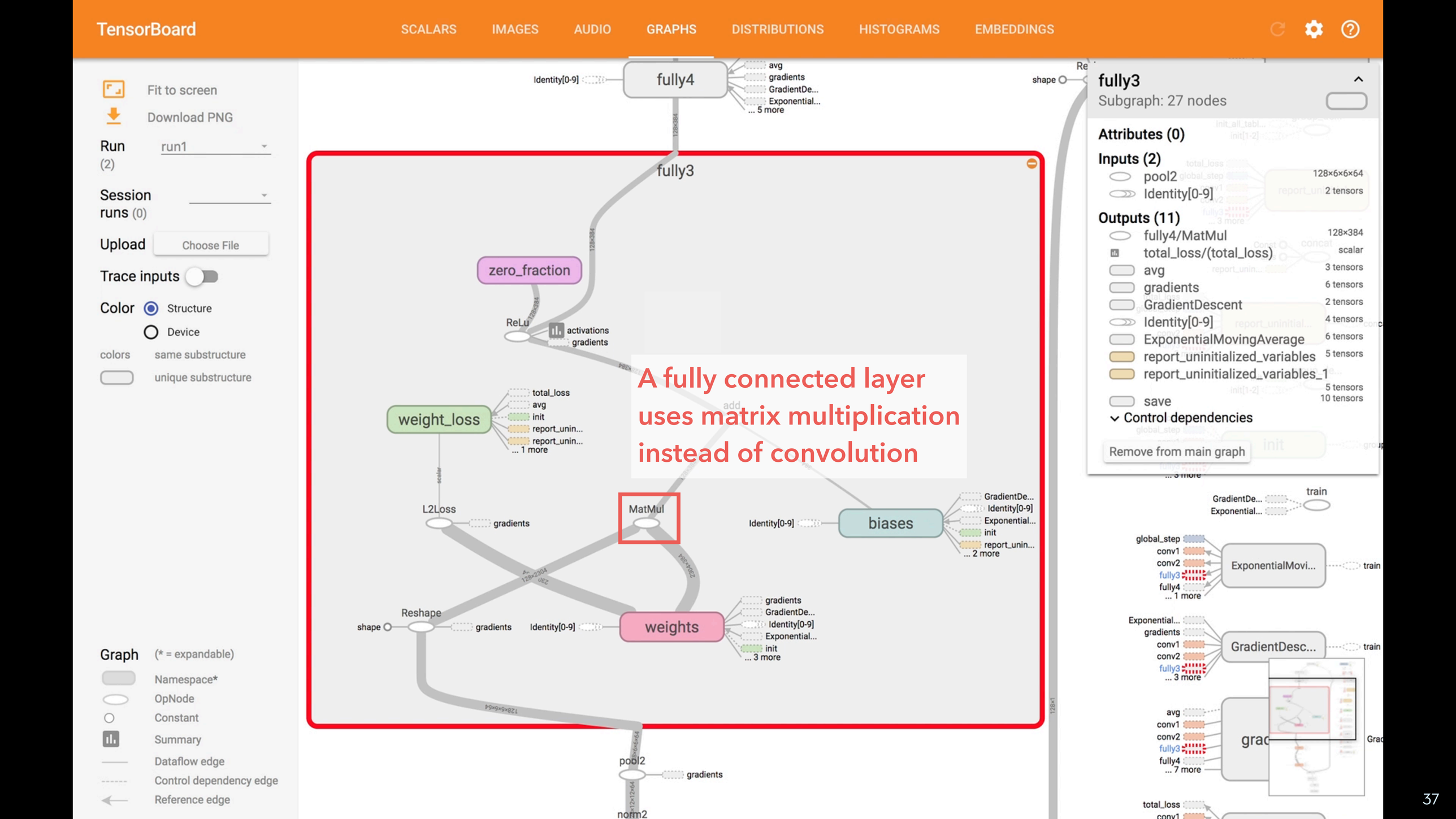
total_loss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... 1 more
A fully connected layer
uses matrix multiplication
instead of convolution
L2Loss
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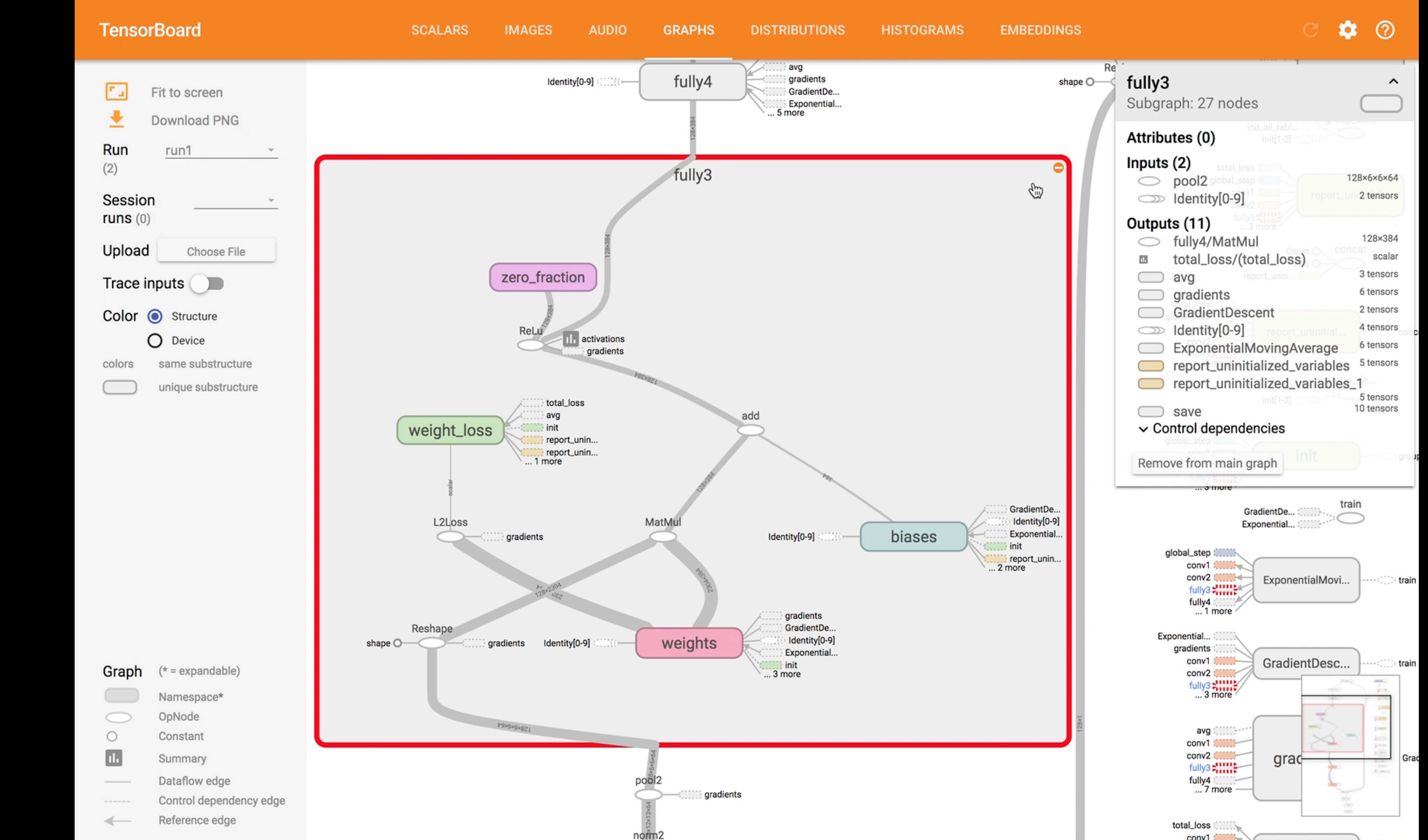
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GradientDesc...
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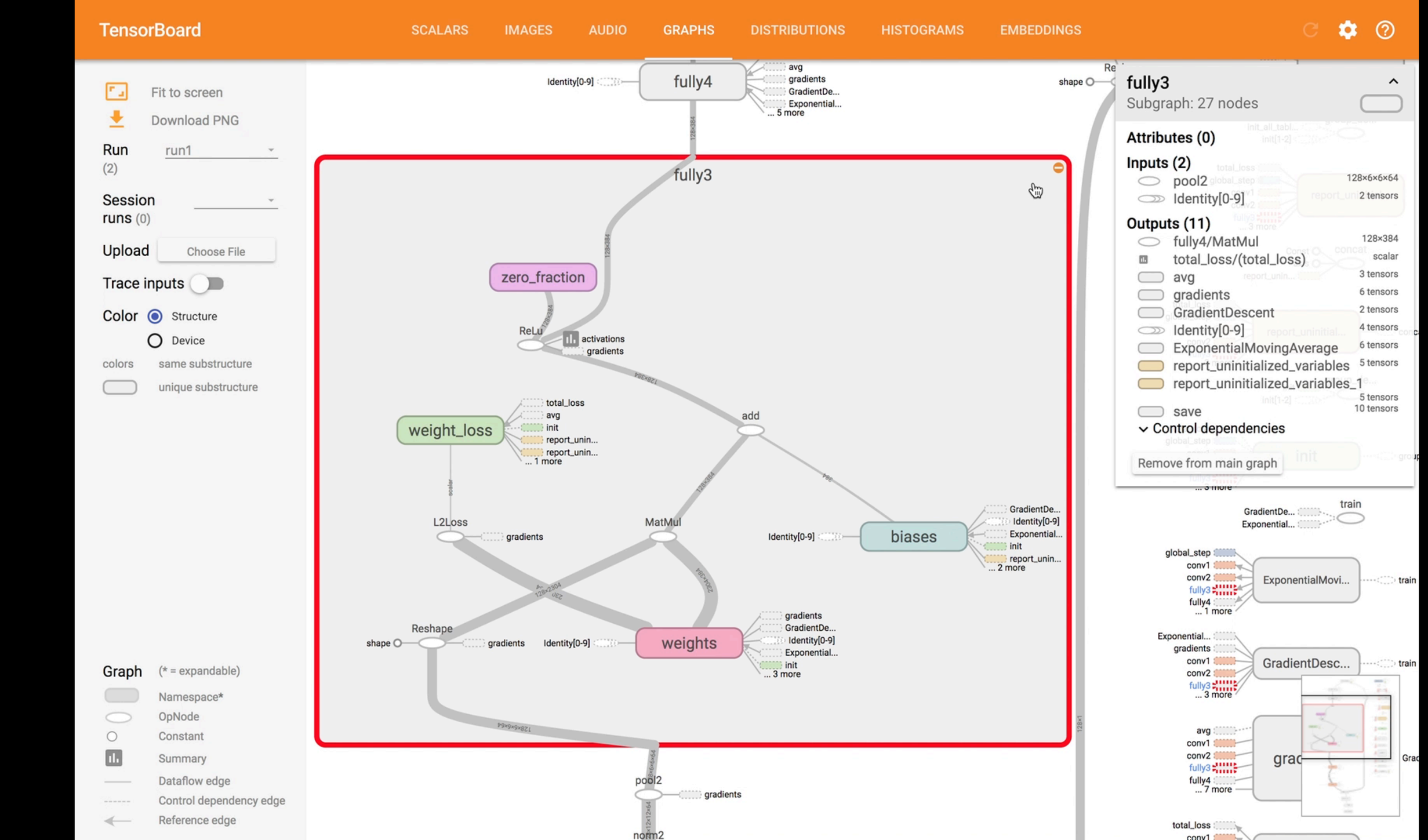
total_loss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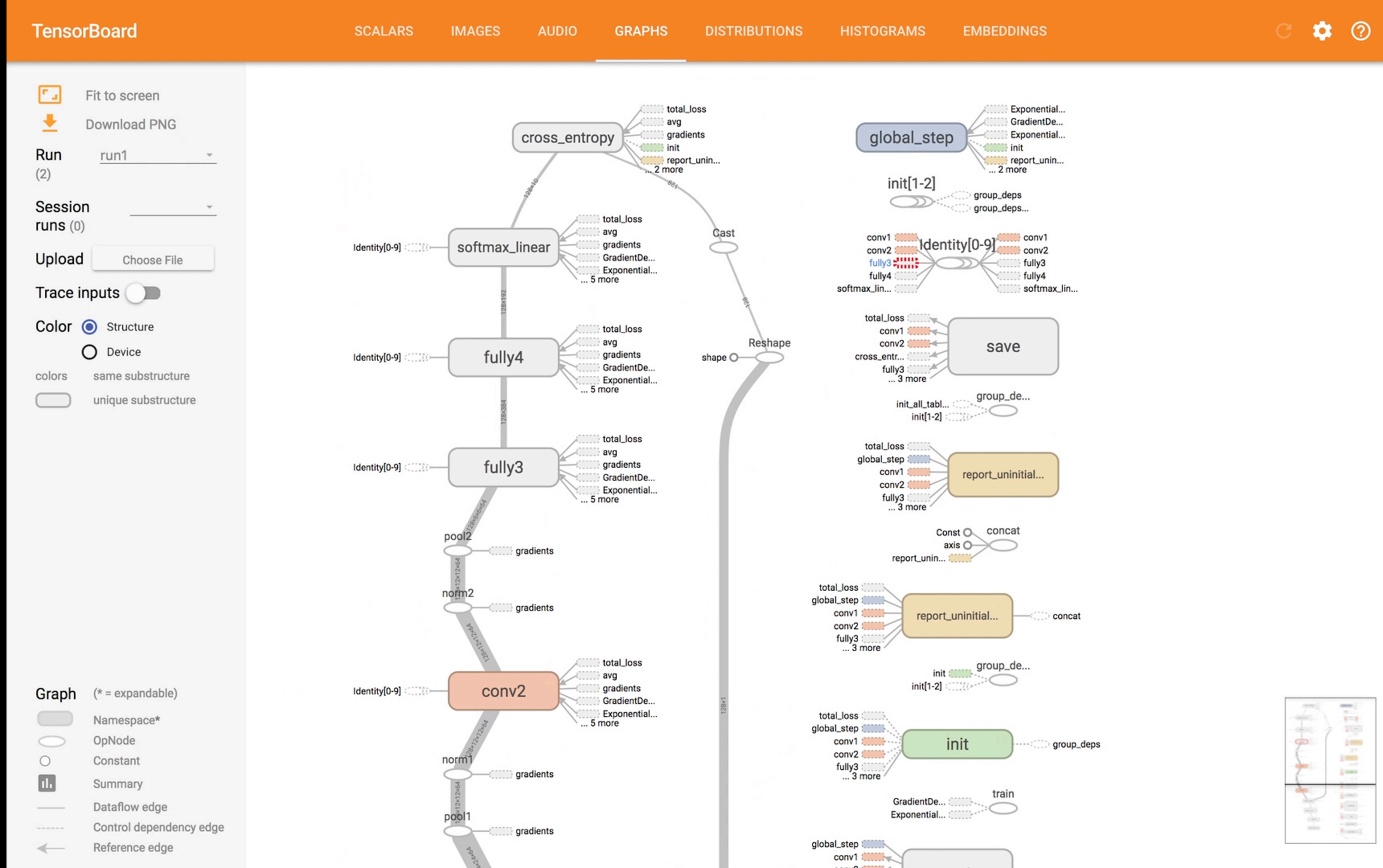
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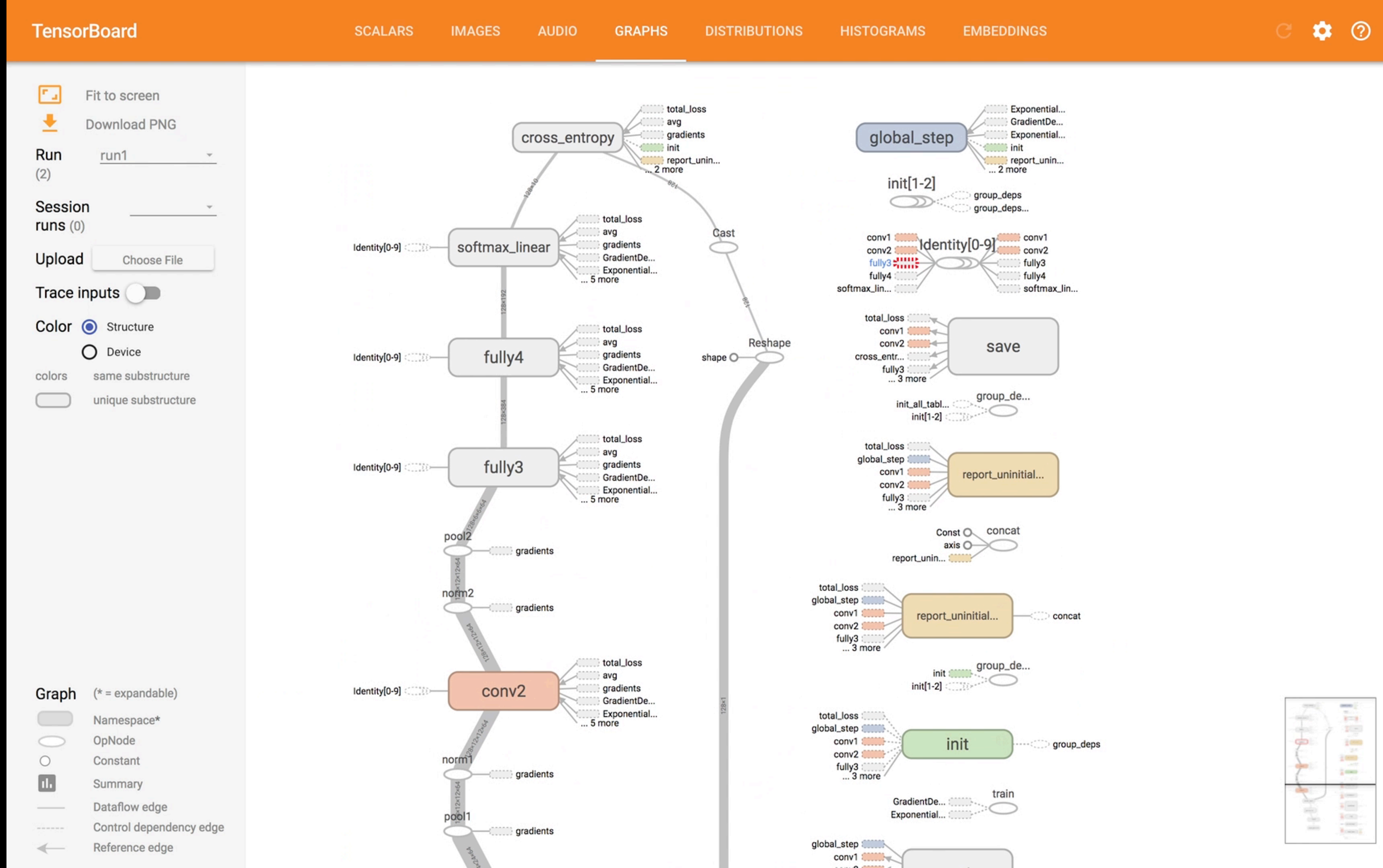
Exponential...
... 5 more
... 2 more
... 3 more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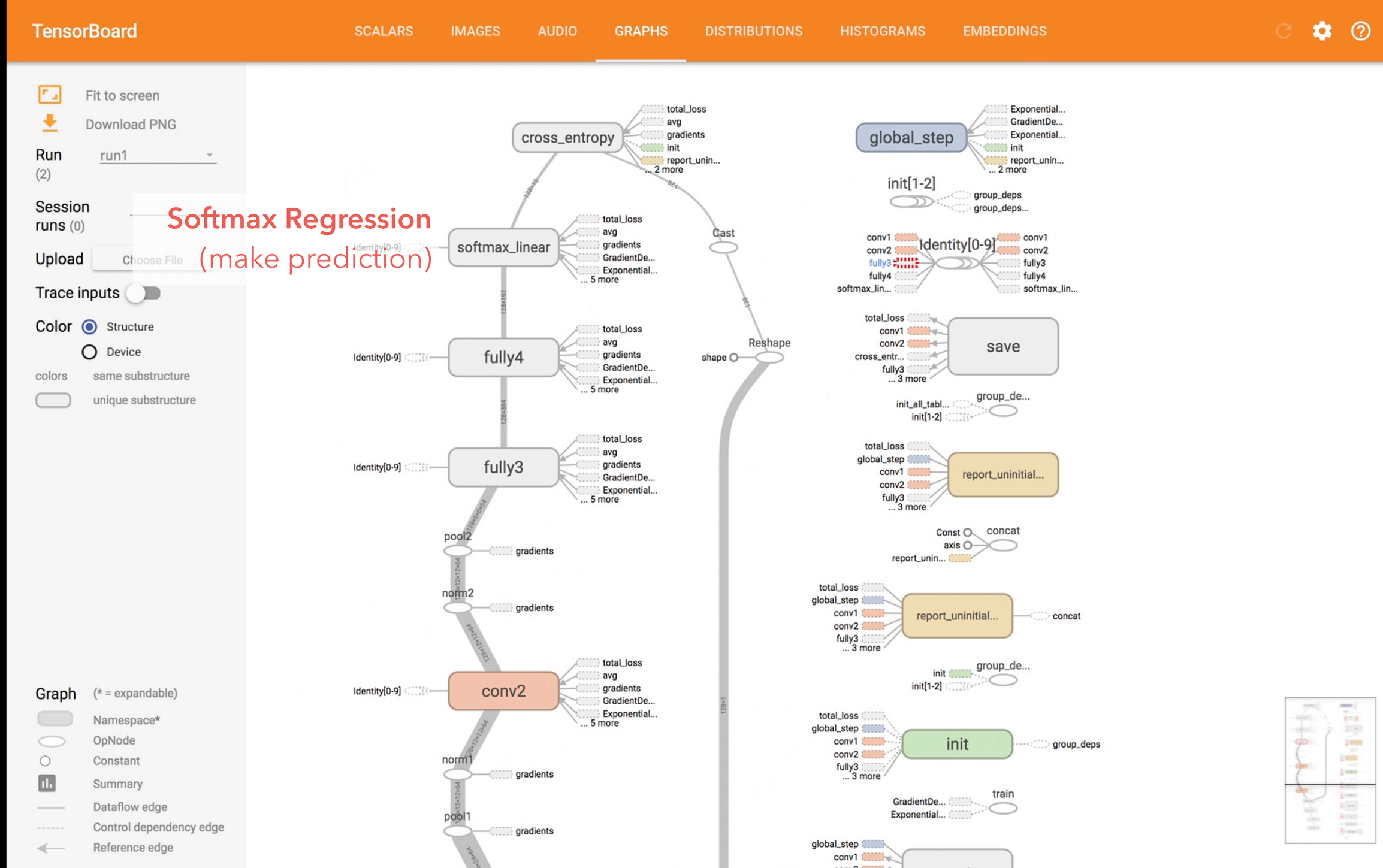
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Identity[0-9]
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gradients
GradientDe...
Exponential...
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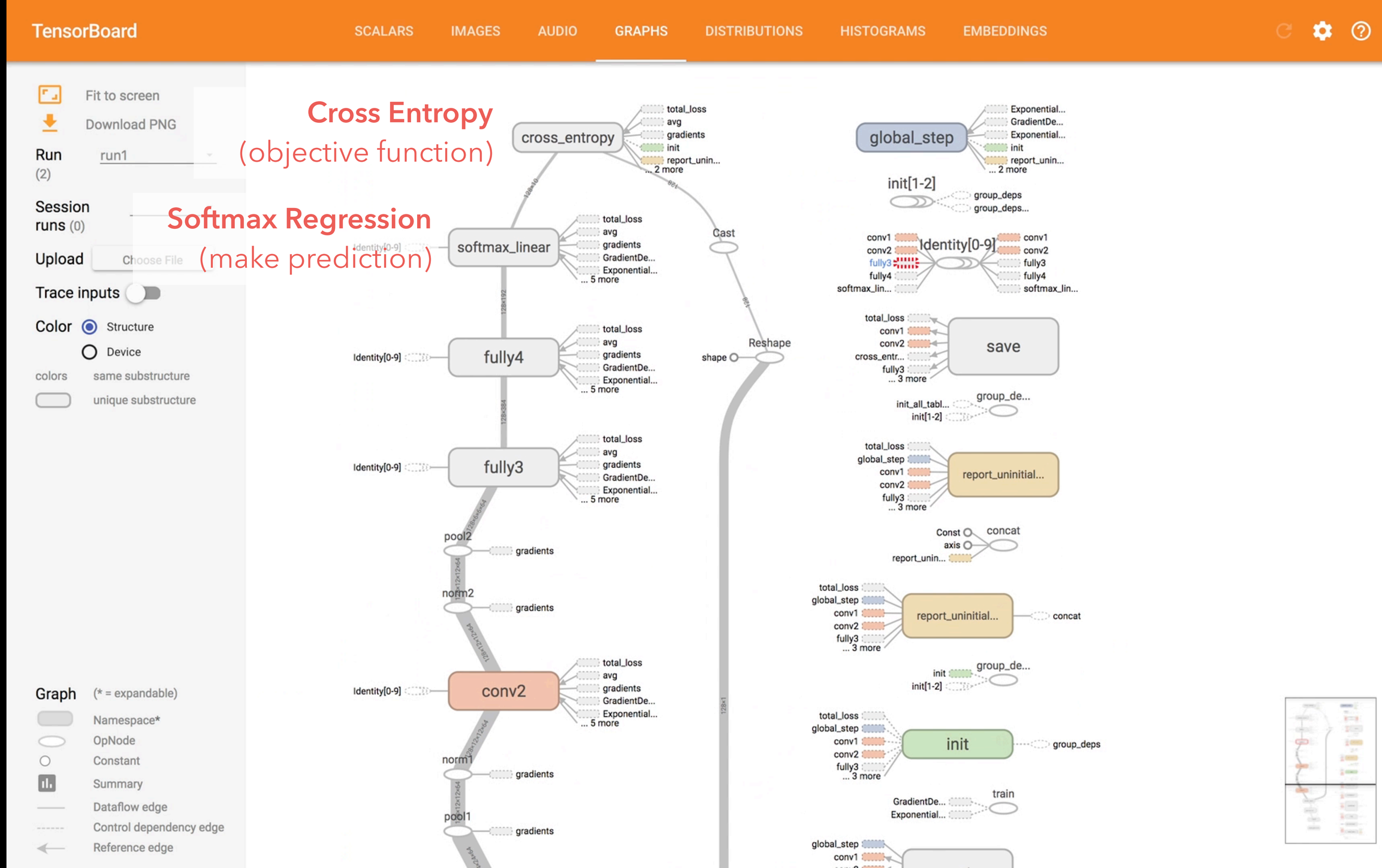
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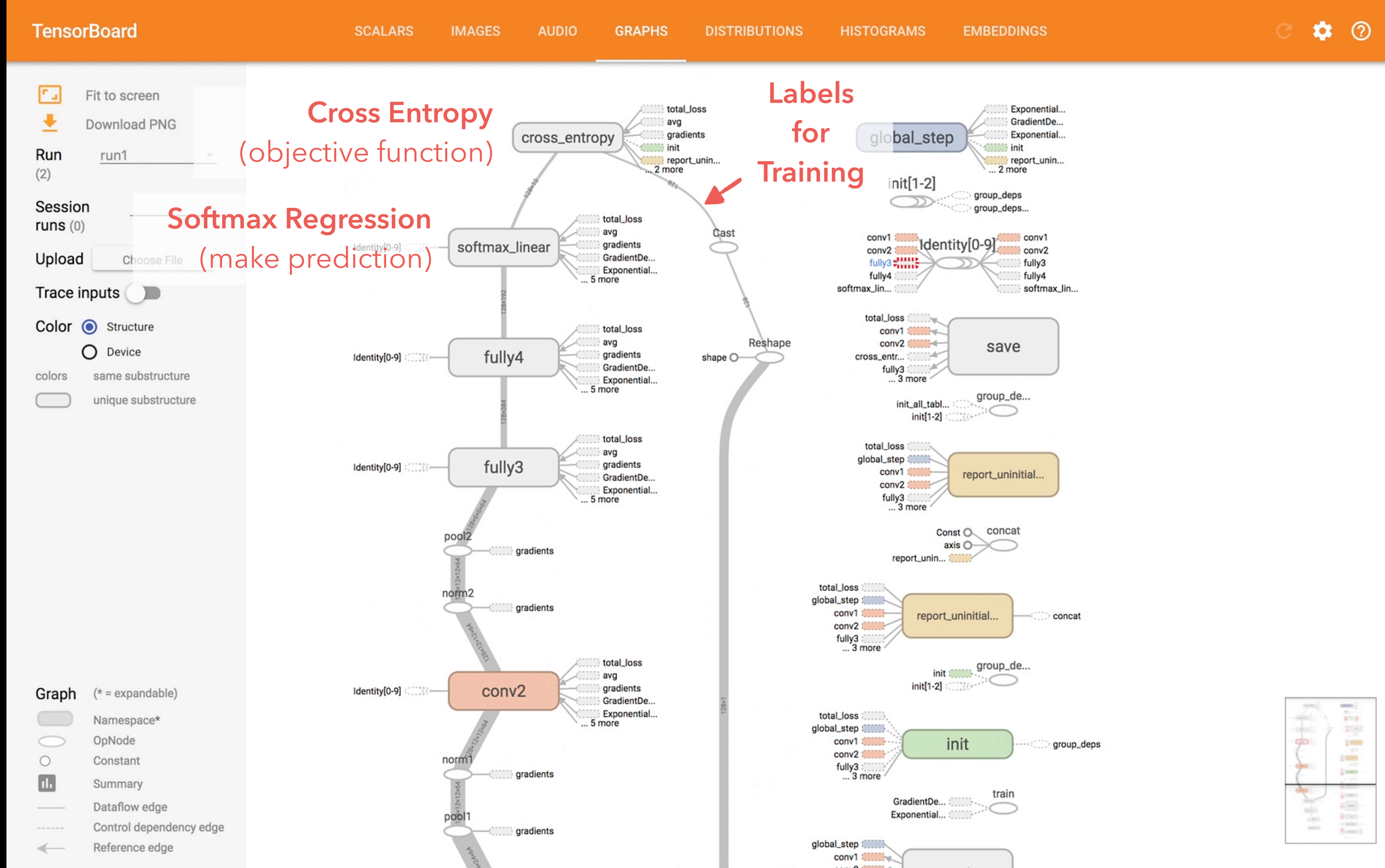
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Exponential...

TensorFlow Graph Visualizer

Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow

TensorFlow Graph Visualizer

Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow

Introduction

Explore a Convolutional Network

Transformation Strategies

Usage Pattern & Feedback

Strategy 1. Extract Less Important Nodes

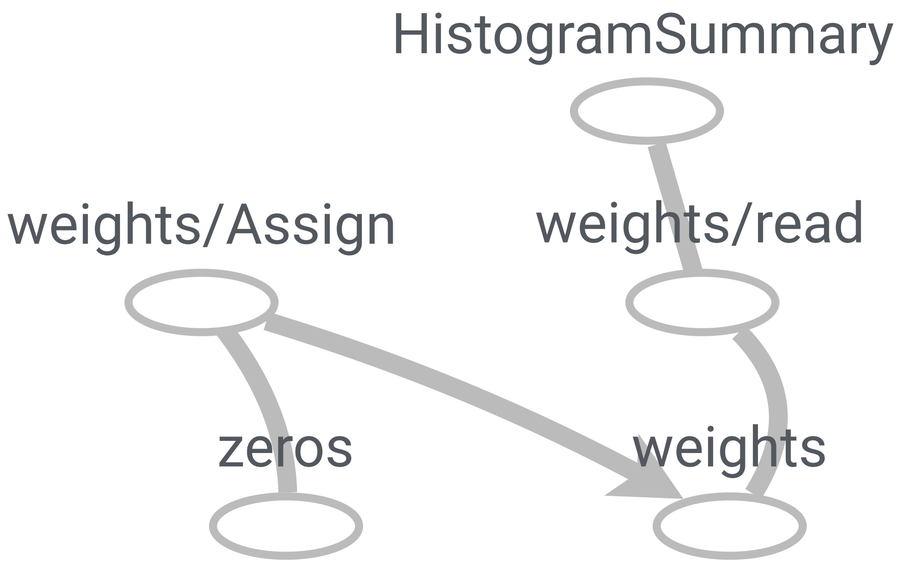
Related: Dunne & Shneiderman 2013, Van Ham & Wattenberg 2008

Extract Less Important Nodes

Some operations are common, but do not help distinguish different models.

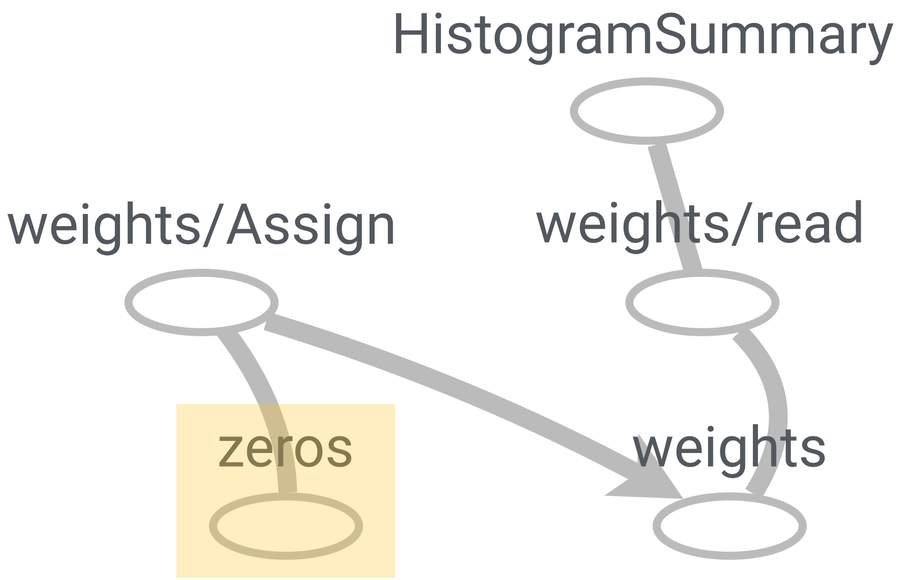
Extract Less Important Nodes

Some operations are common, but do not help distinguish different models.



Extract Less Important Nodes

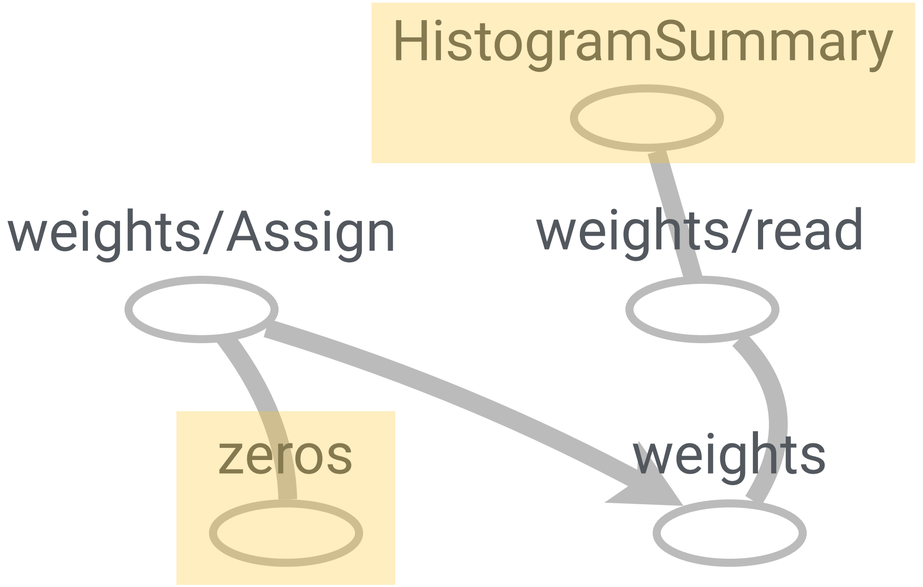
Some operations are common, but do not help distinguish different models.



A **constant** operation.
(considered as a parameter)

Extract Less Important Nodes

Some operations are common, but do not help distinguish different models.

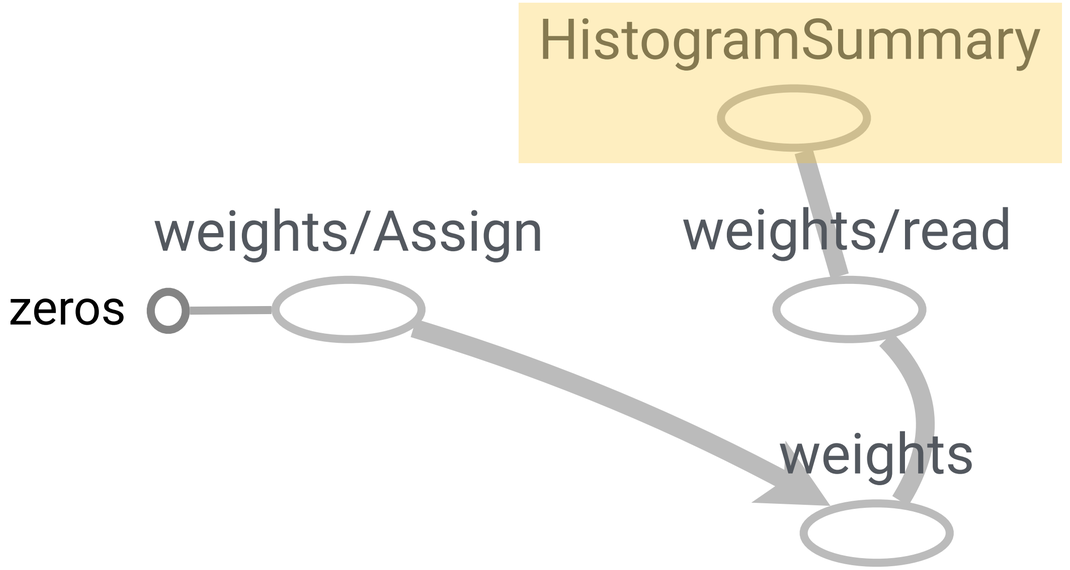


Summary operations.
(for logging data)

A **constant** operation.
(considered as a parameter)

Extract Less Important Nodes

Some operations are common, but do not help distinguish different models.



Summary operations.
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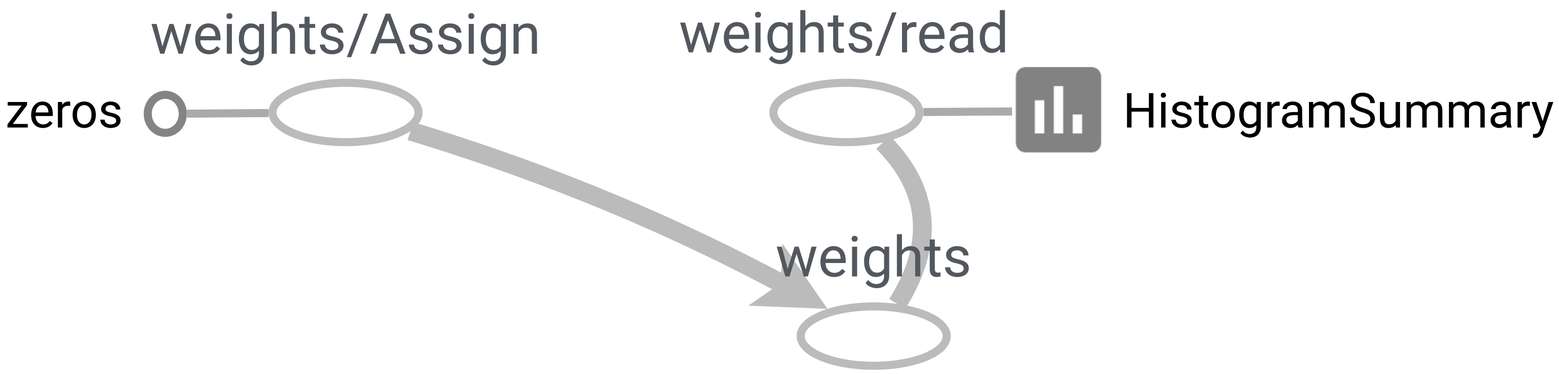

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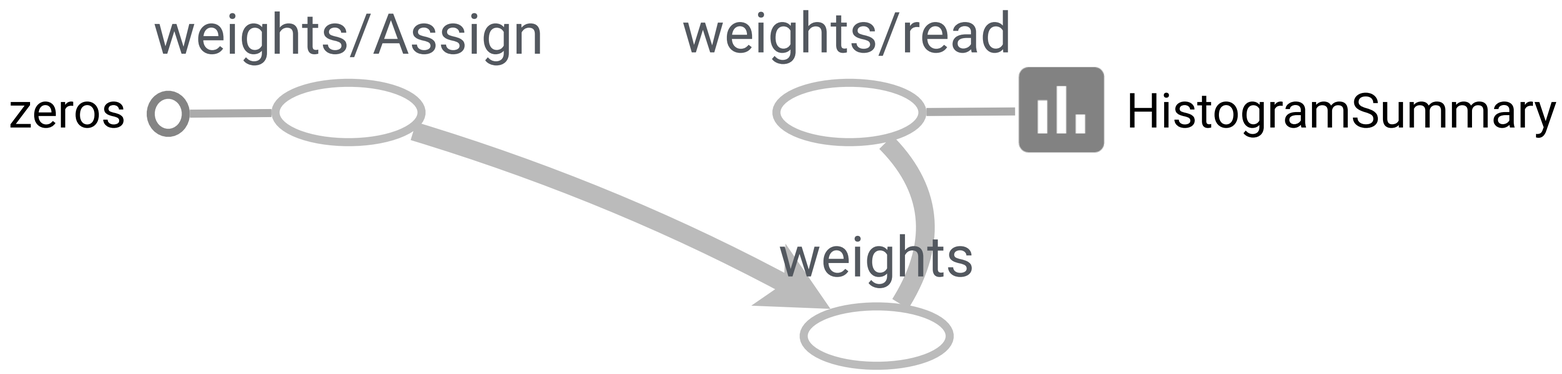


Constants and summaries always connect to only one other operations.
Extracting them do not change path between other nodes

Strategy 2. Build a Hierarchical Clustered Graph

Related: Archambault et al. 2008, Gansner et al. 2005, Balzer et al. 2007

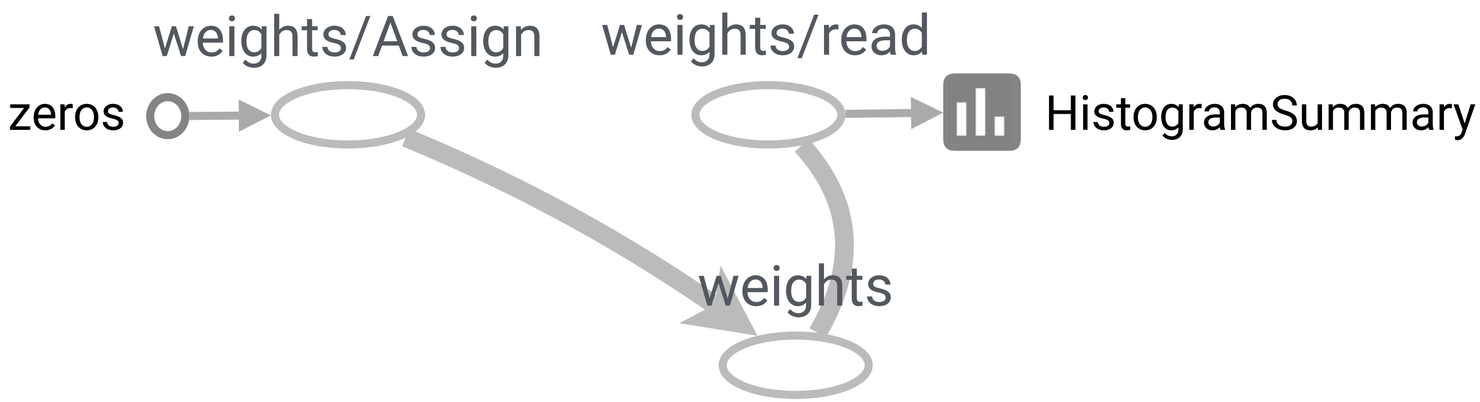
How do we group the nodes?

Let Users Specify Hierarchy to Group Nodes

Let Users Specify Hierarchy to Group Nodes

```
W = tf.Variable(zeros, name='weights')
```

User can give nodes
a *directory-like* namespace
(originally for non-visual debugging)



Let Users Specify Hierarchy to Group Nodes

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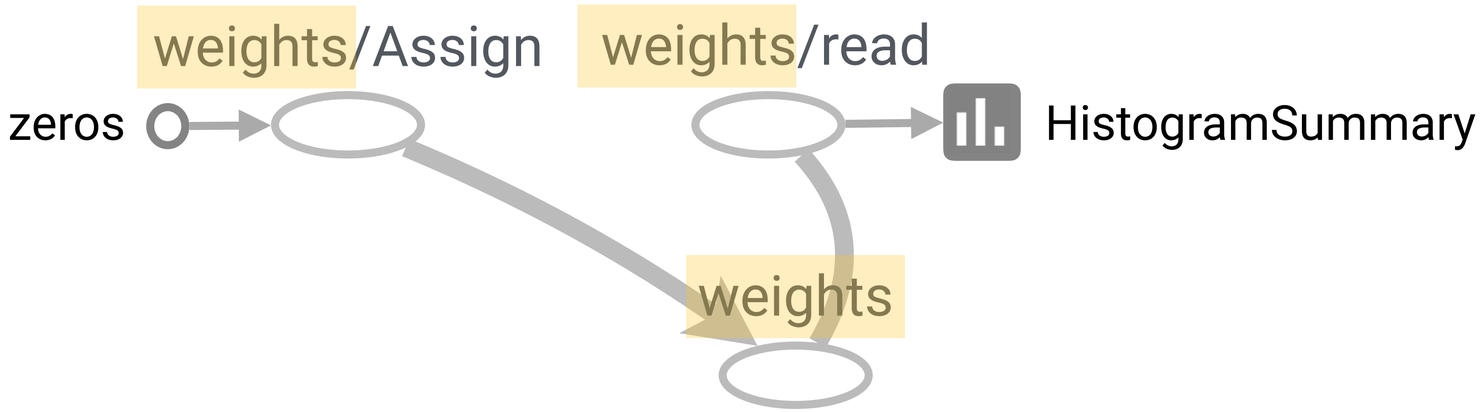
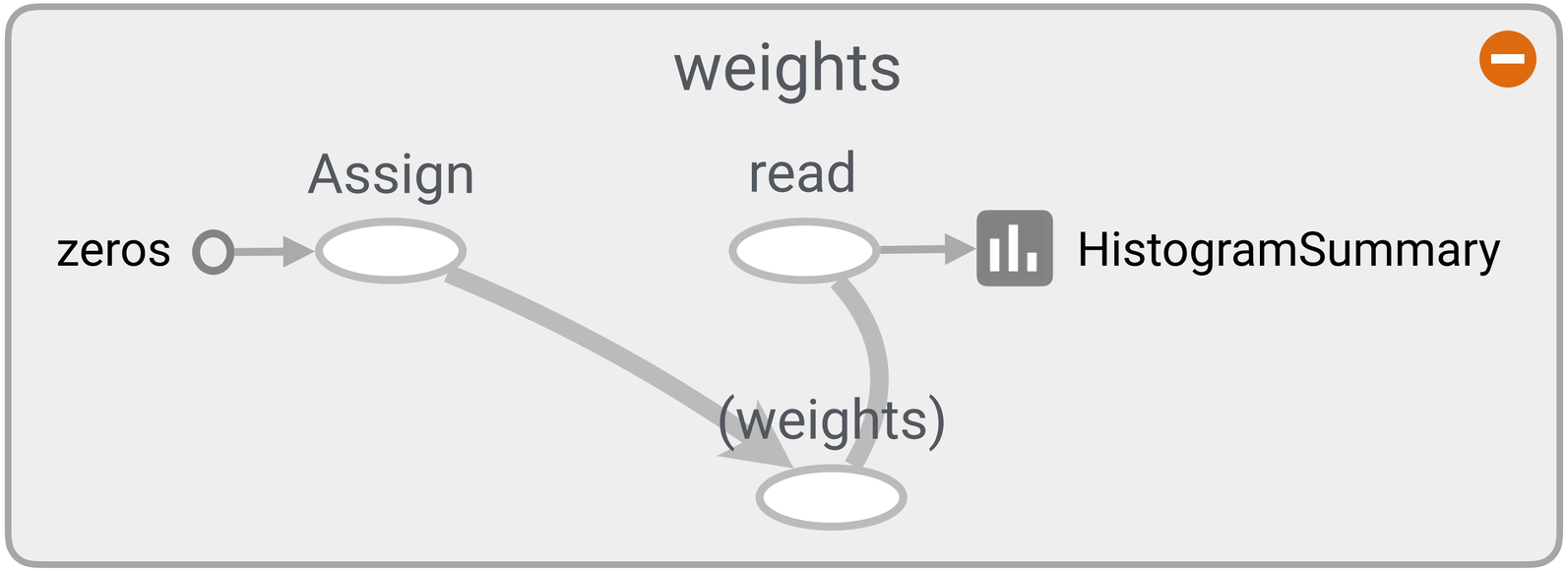
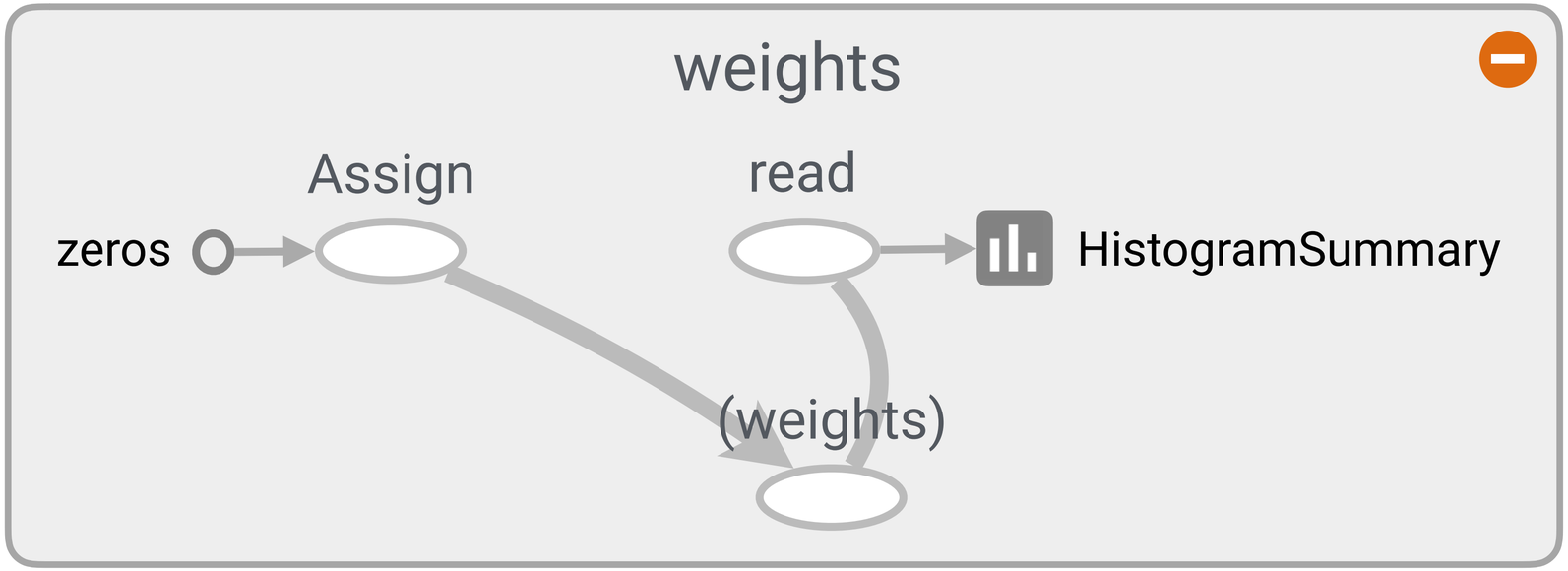


Let Users Specify Hierarchy to Group Nodes



Let Users Specify Hierarchy to Group Nodes

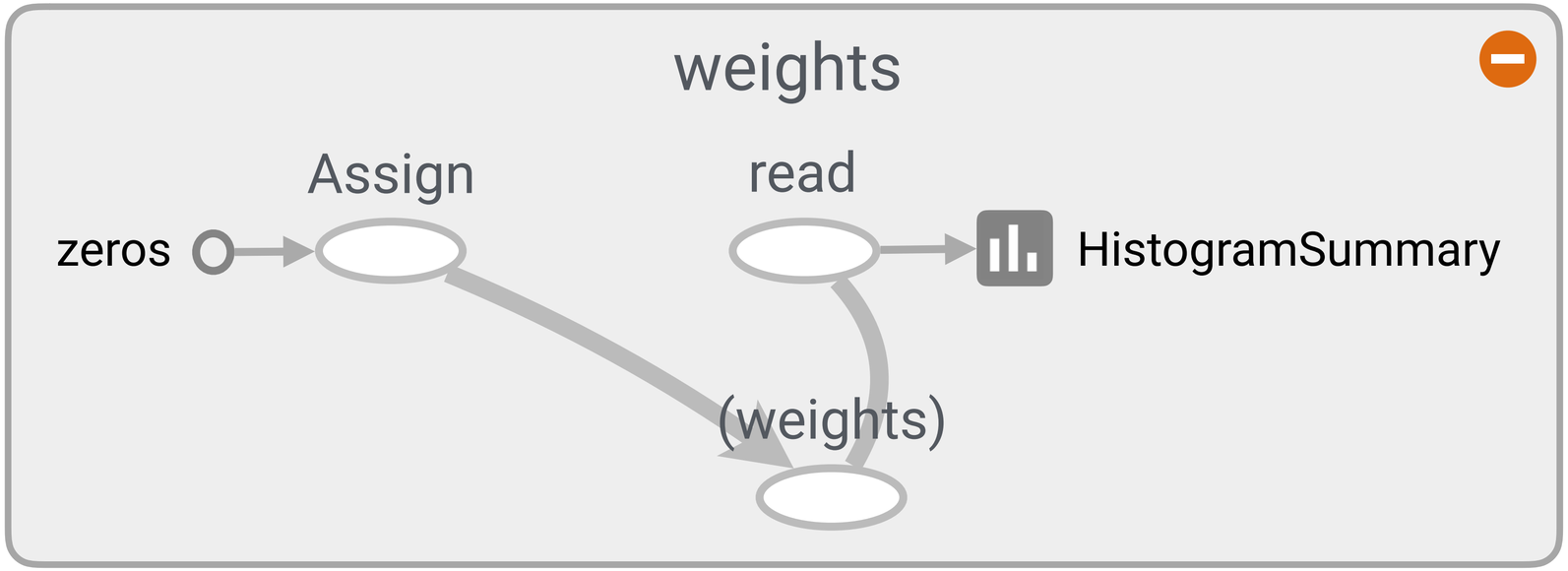
Names are optional but easy to add.



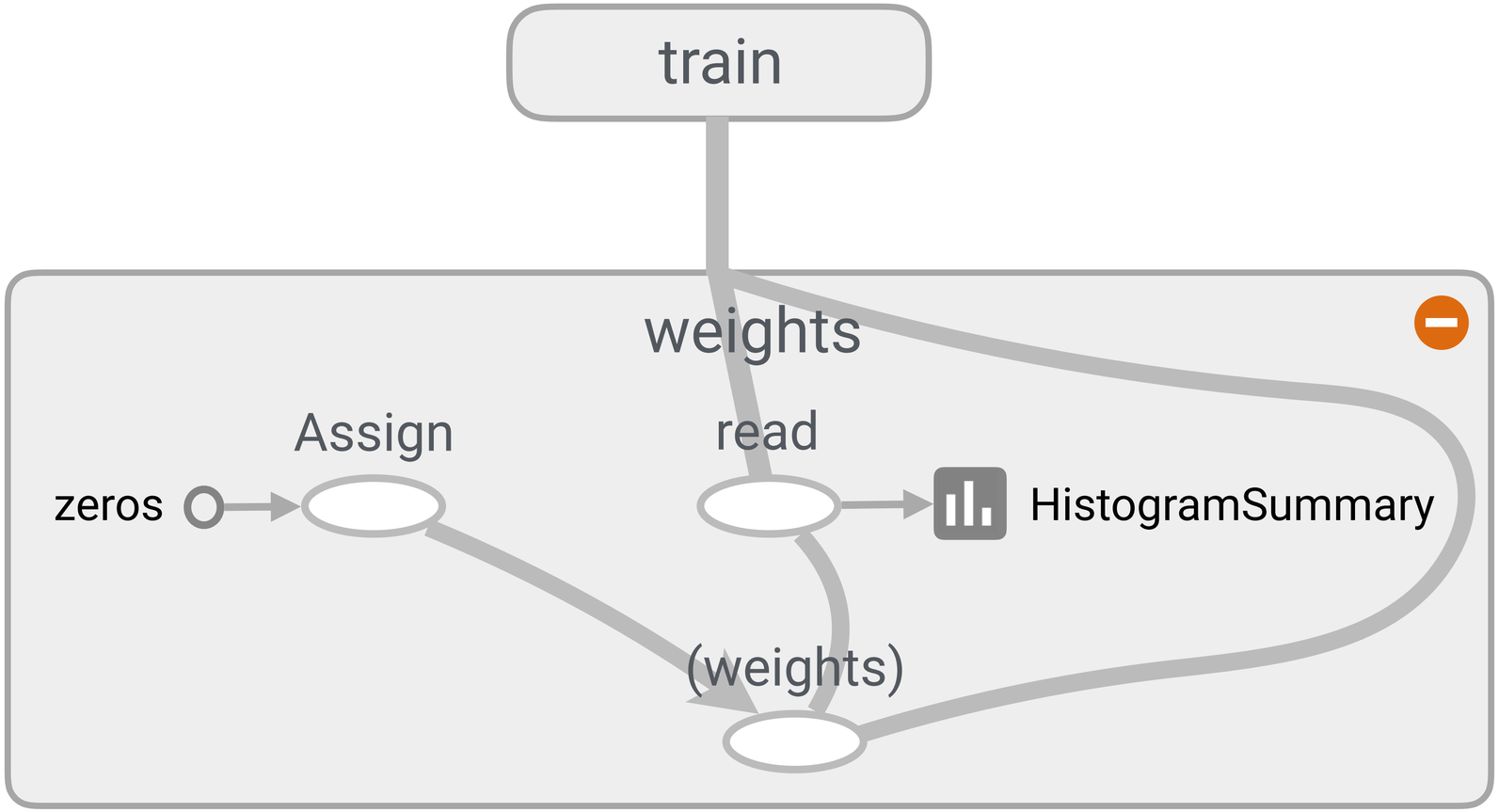
Let Users Specify Hierarchy to Group Nodes

Names are optional but easy to add.

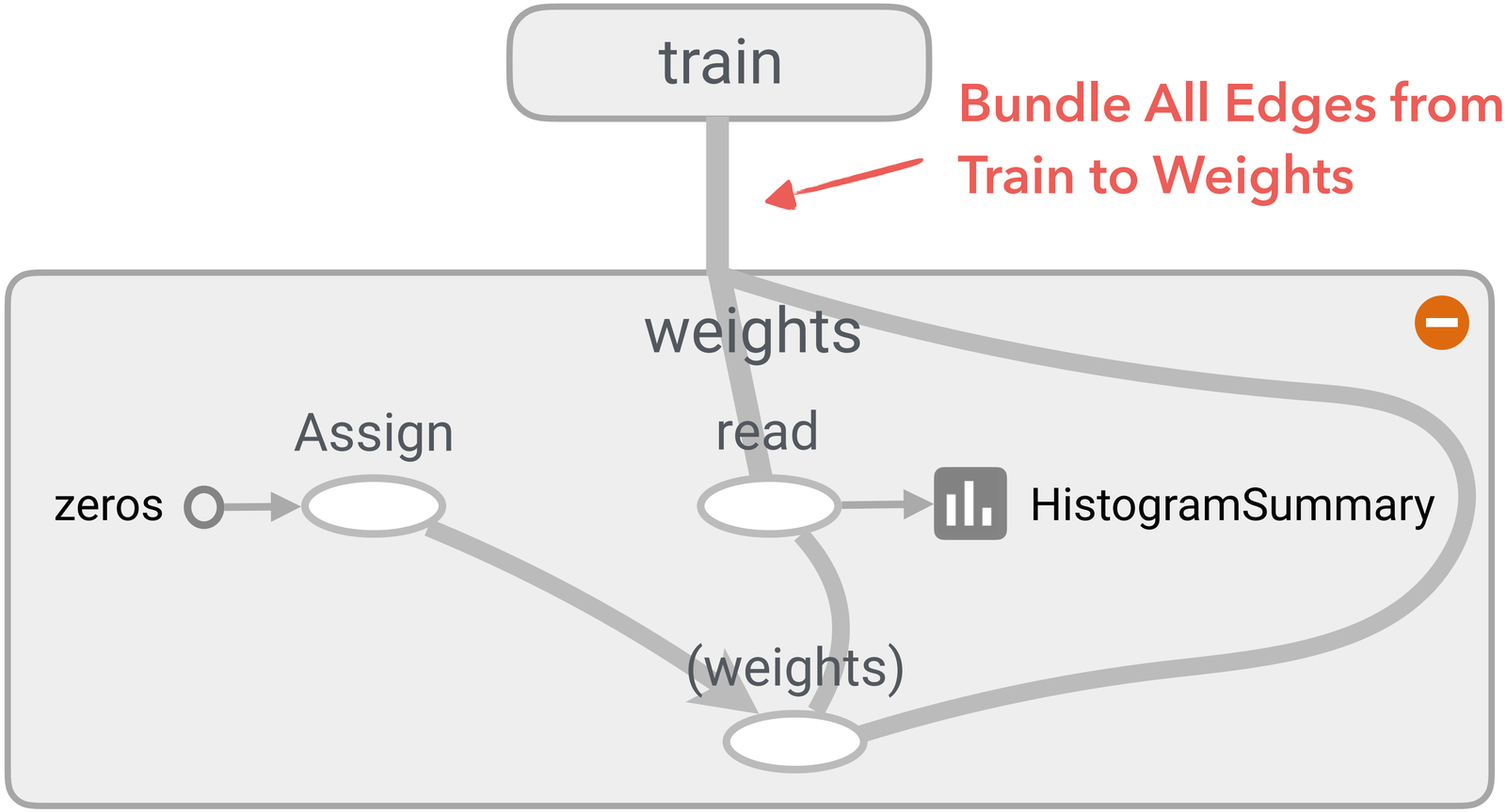
Plus, users already used names with non-visual debugging tools.



Bundle All Edges between Groups



Bundle All Edges between Groups



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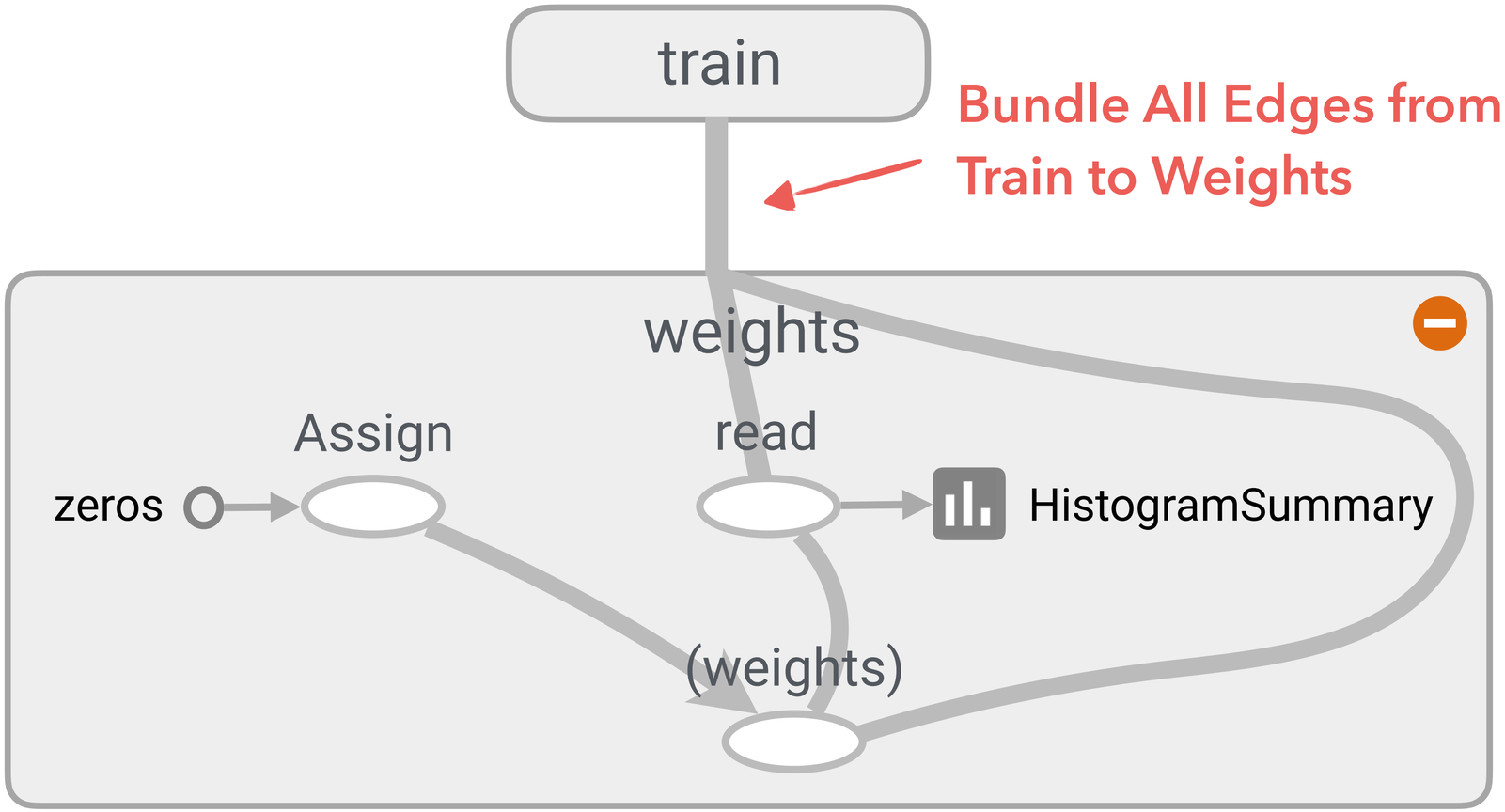
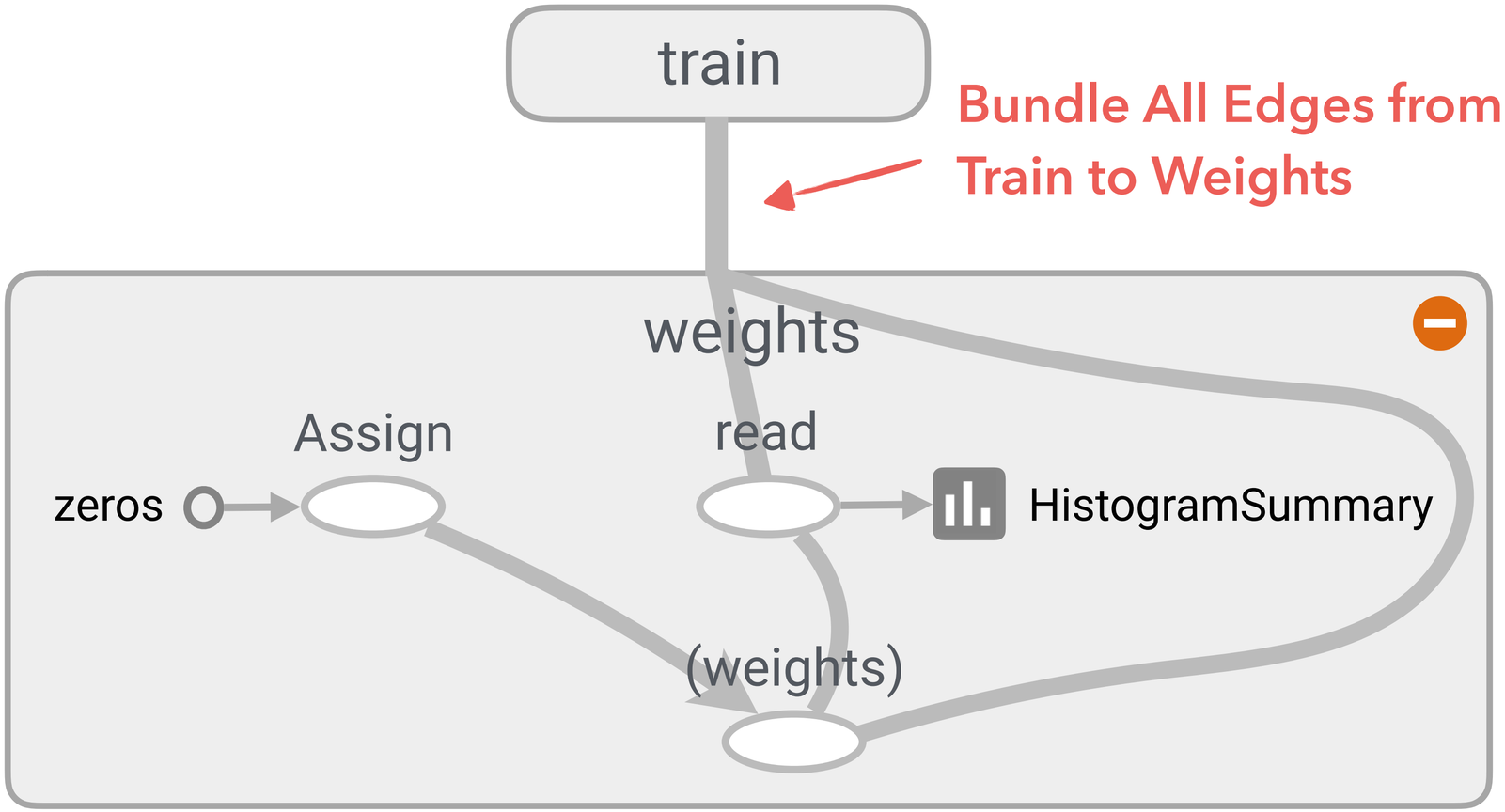


Faster Layout Calculation
(recursively calculate
layout for each group)

Bundle All Edges between Groups



Faster Layout Calculation
(recursively calculate
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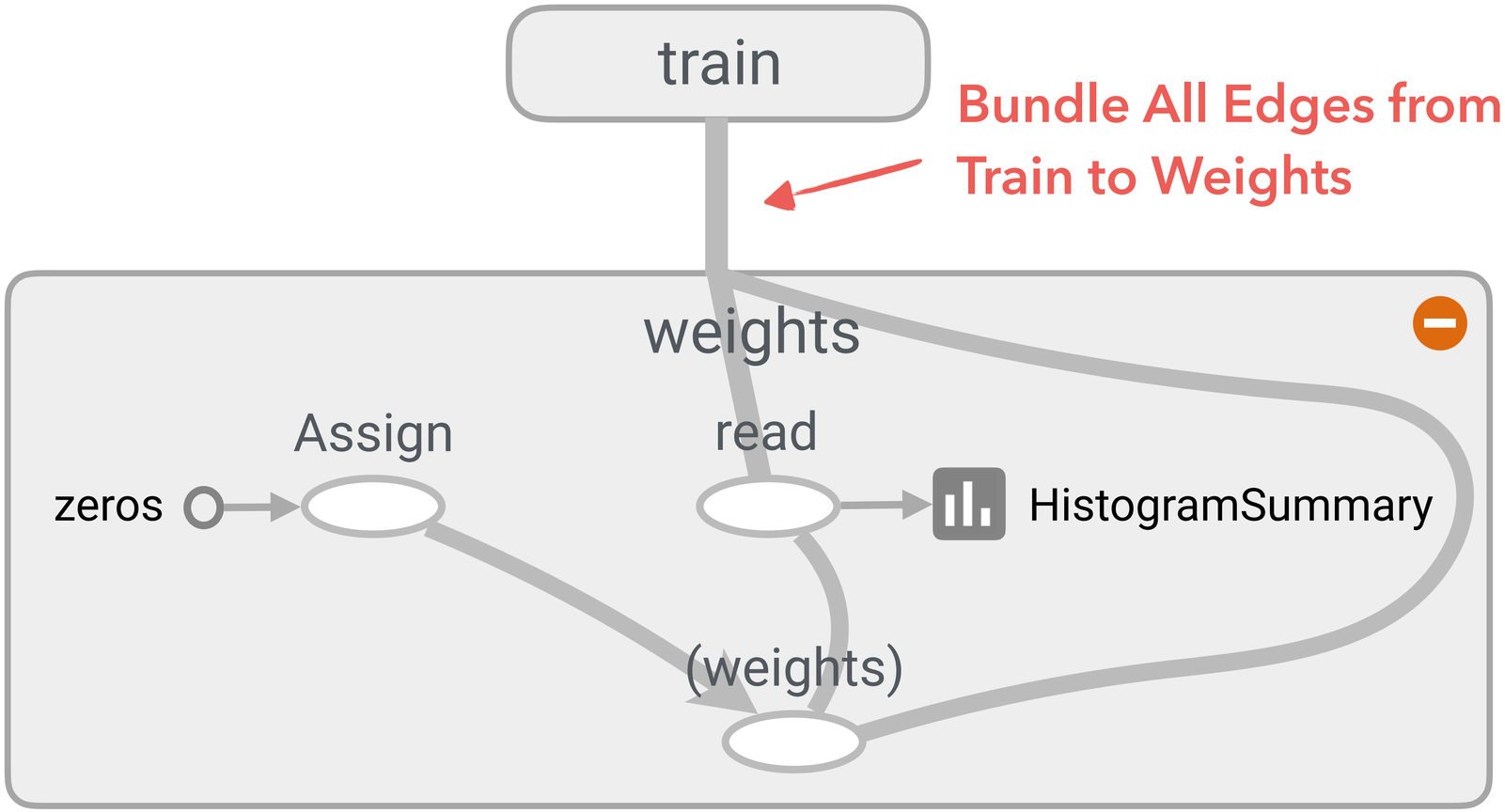
Make layout stable
on expansion

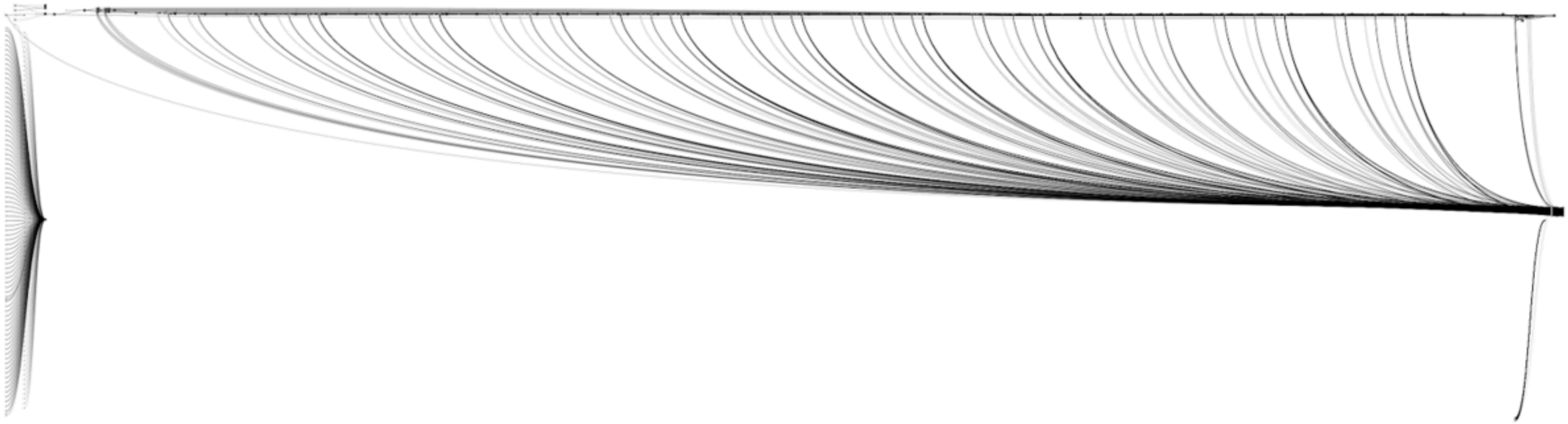
Bundle All Edges between Groups

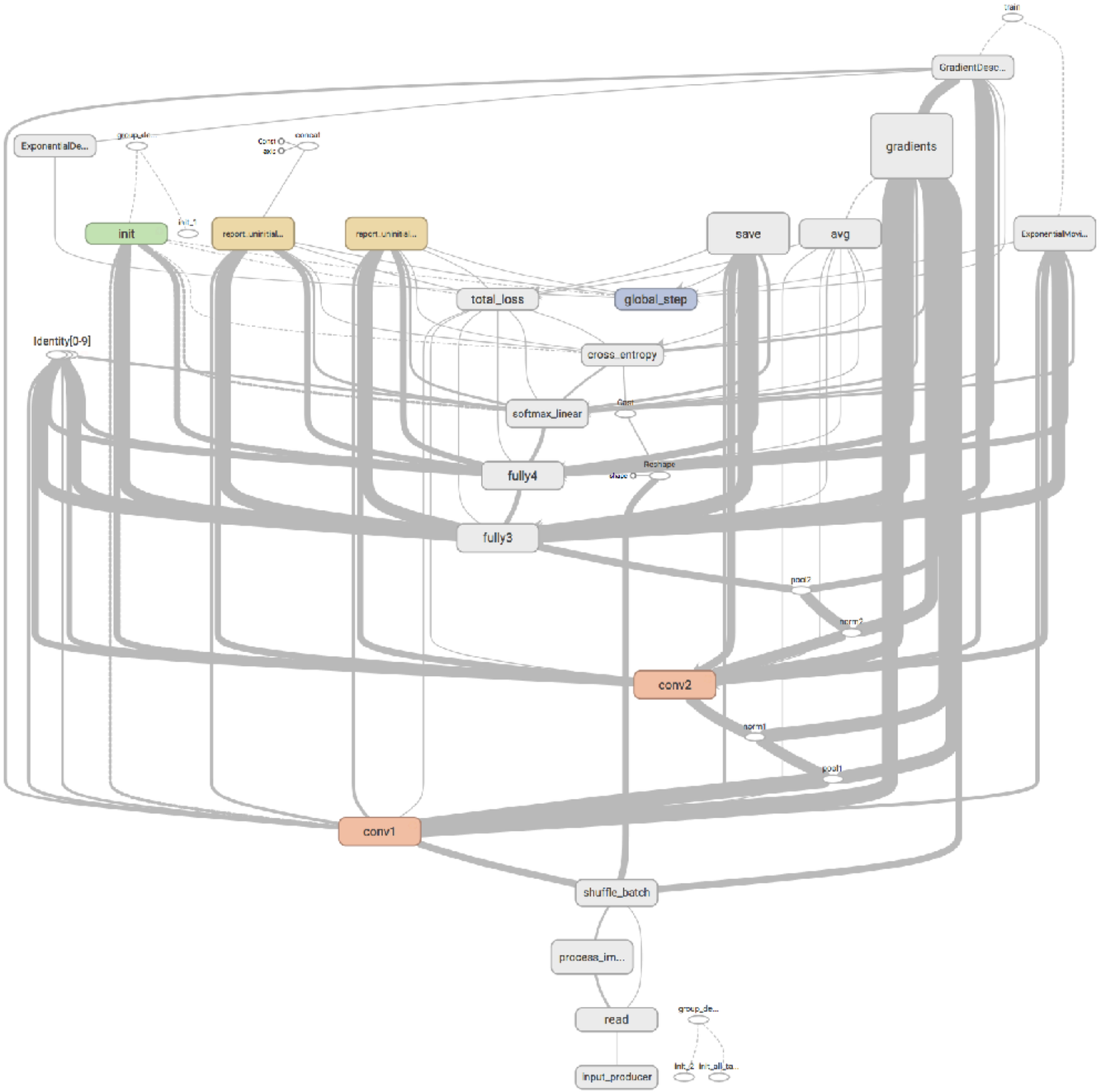


Faster Layout Calculation
(recursively calculate
layout for each group)

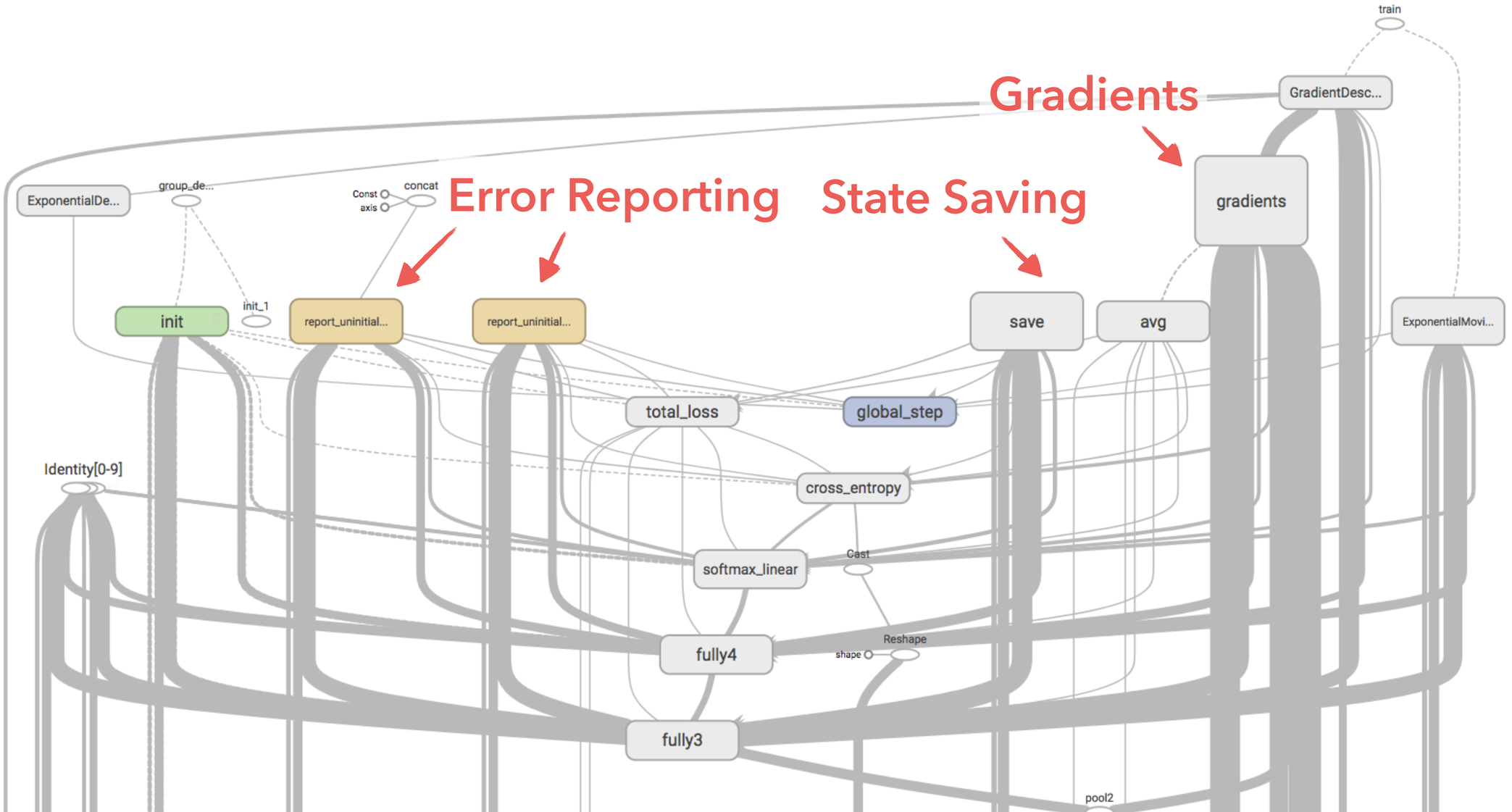
Make layout stable
on expansion

Reduce edge crossing




GradientDesc...
gradients
ExponentialDe...
init
report_uninitiali...
report_uninitiali...
save
avg
ExponentialMovi...
total_loss
global_step
Identity[0-9]
cross_entropy
softmax_linear
fully4
Reshape
fully3
pool2
norm2
conv2
norm1
pool1
conv1
shuffle_batch
process_im...
read
input_producer

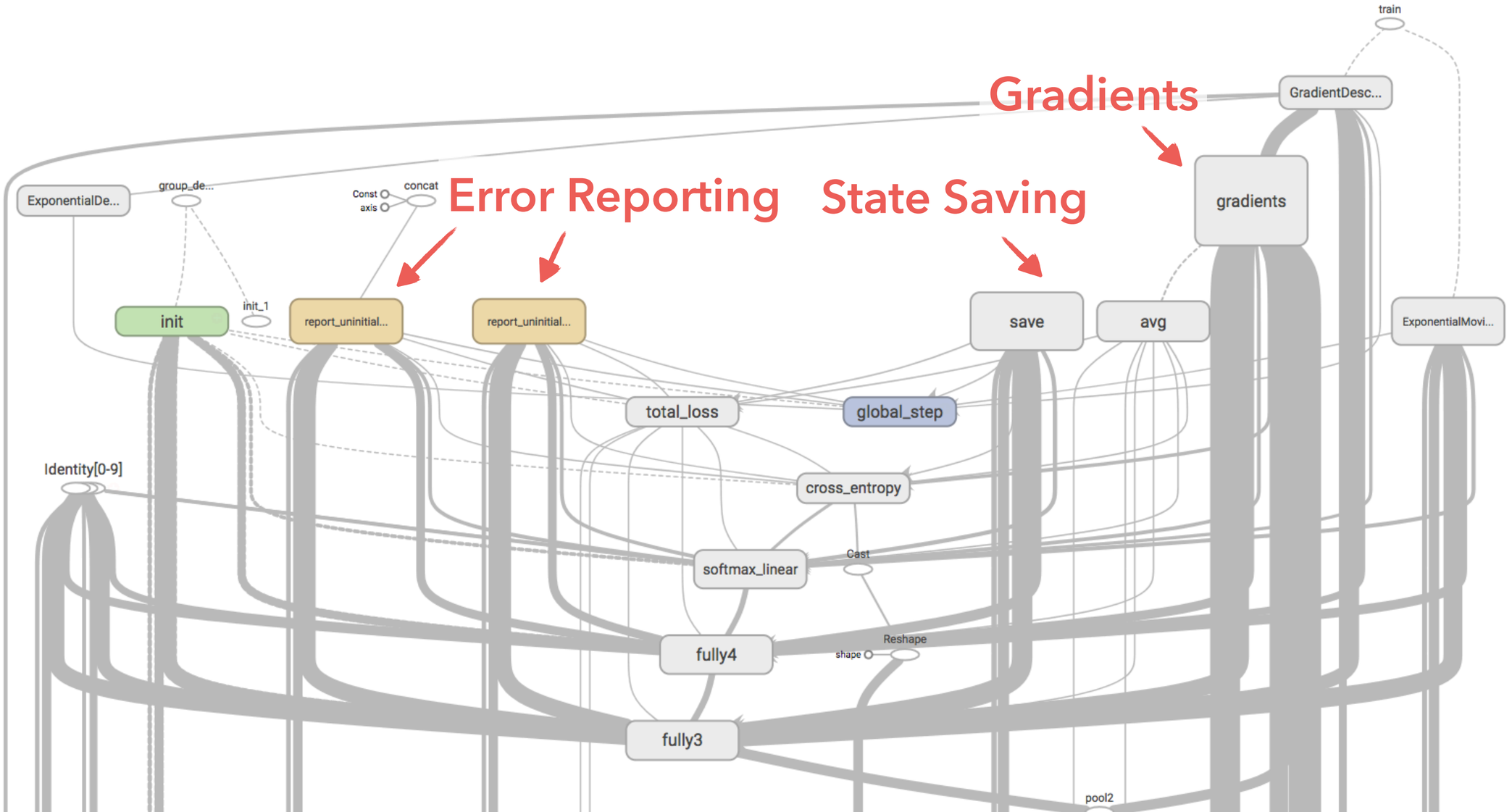
High-degree nodes at the end (and start) connect to all core layers.

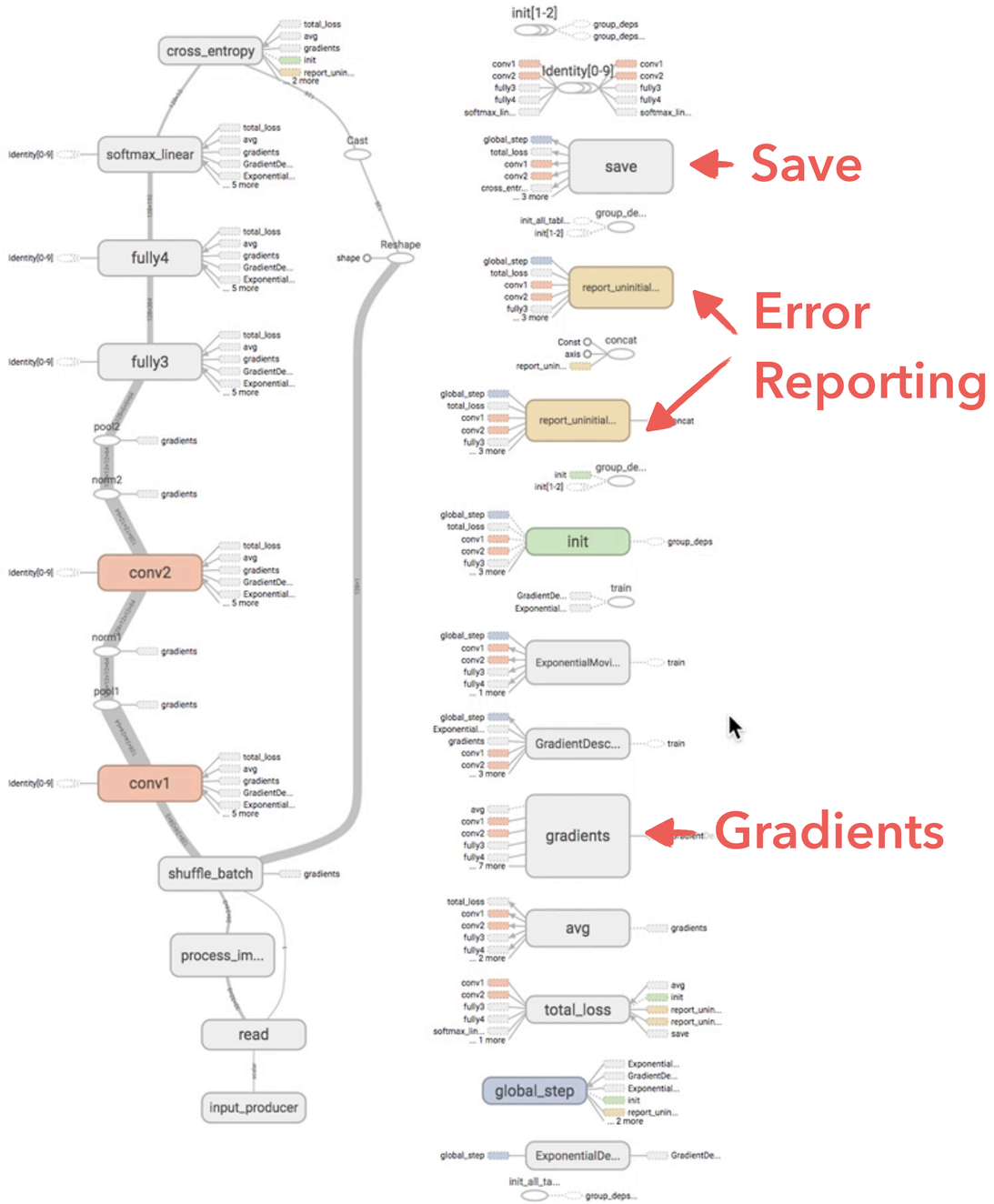


Strategy 1. Extract Less Important Nodes

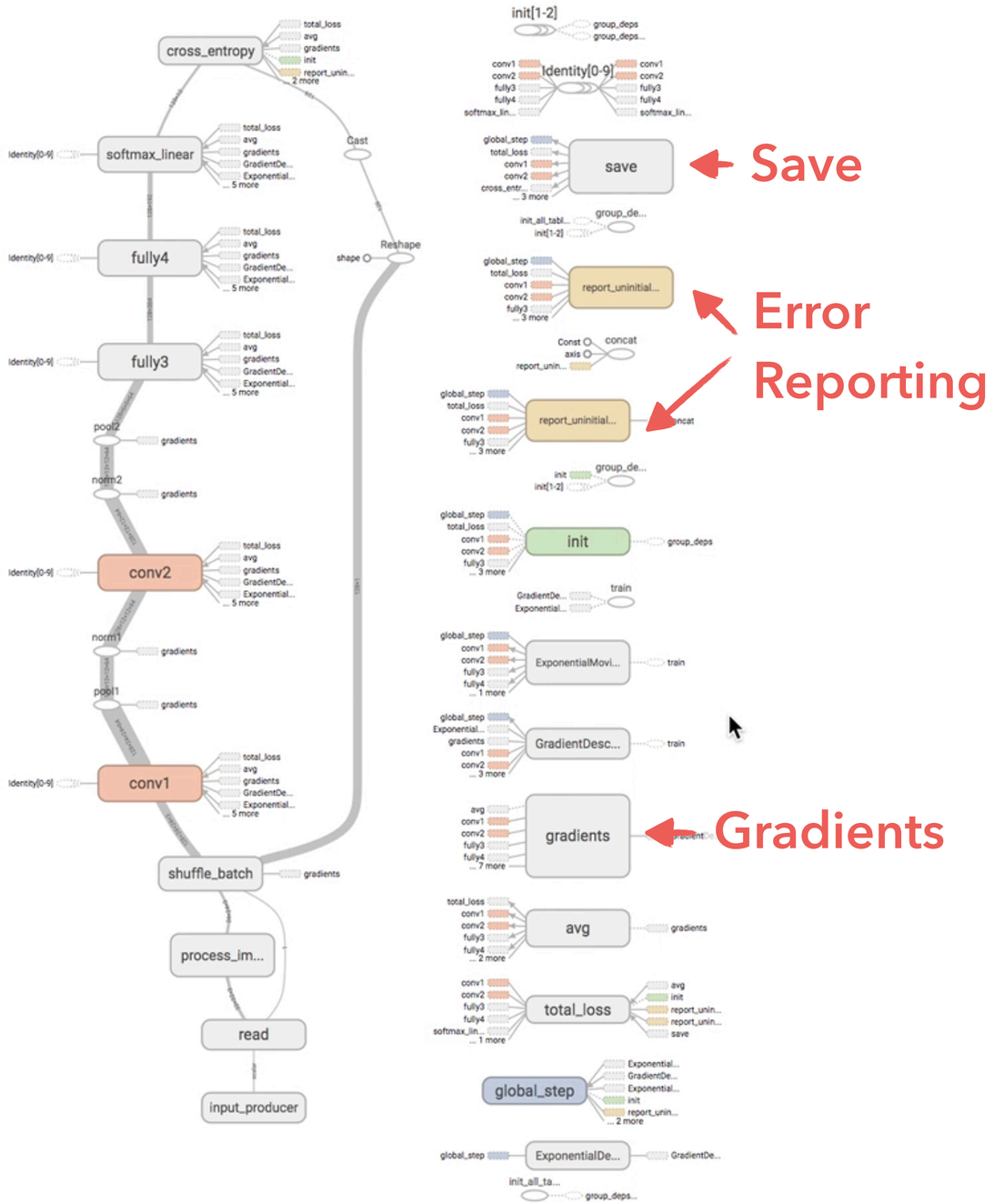
Strategy 1. Extract Less Important Nodes & Groups

High-degree nodes at the end (and start) connect to all core layers.





Extract nodes with
high in-degree at the end (sinks) &
high out-degree at the start (sources)
to the right



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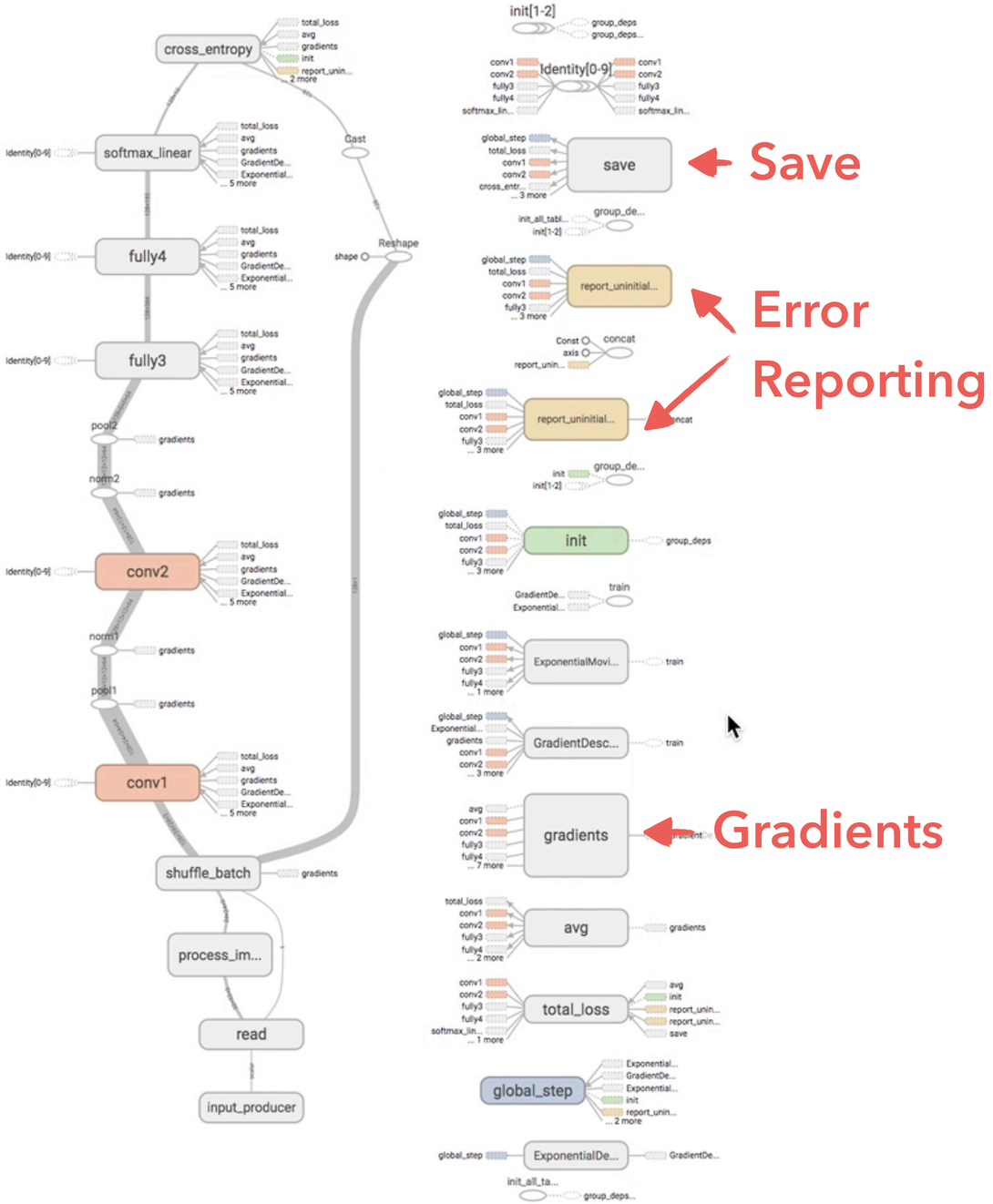

Extract nodes with
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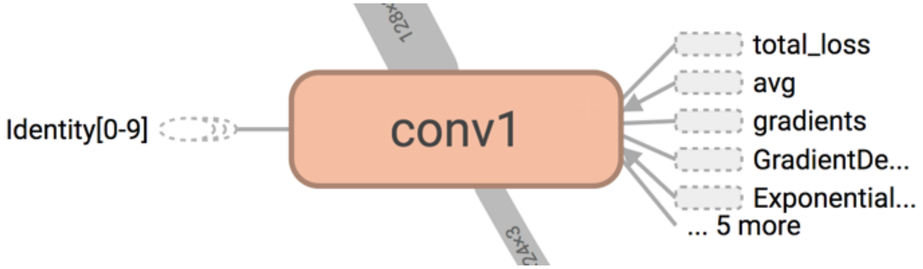
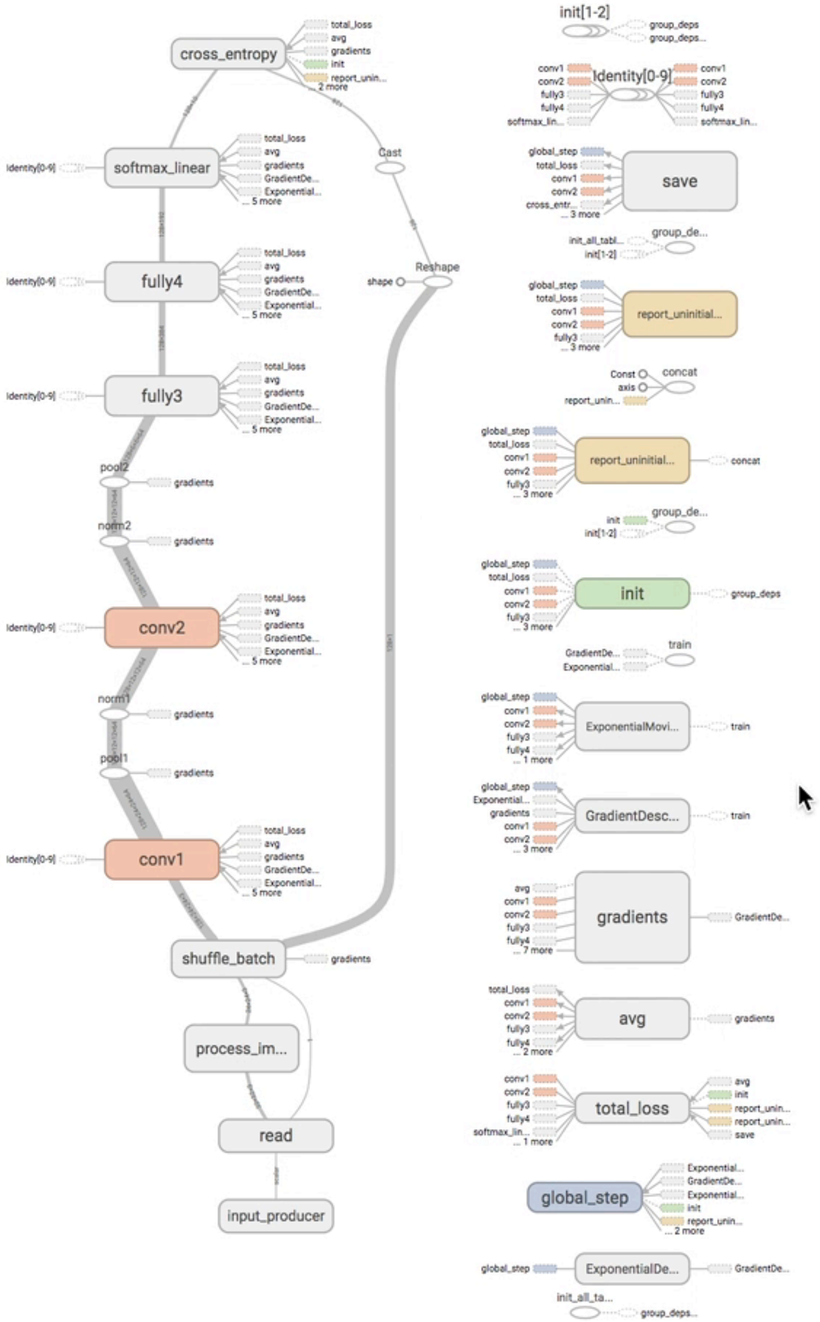
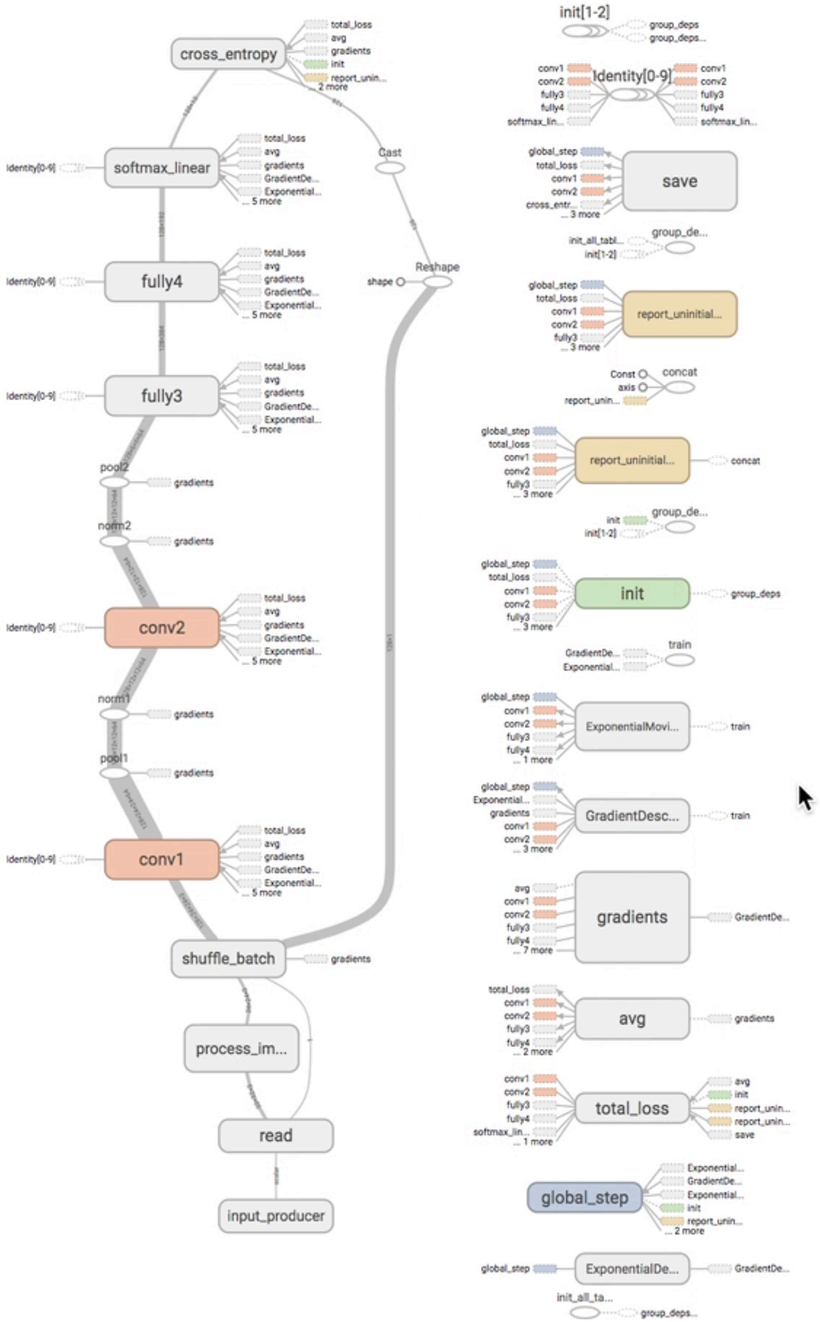
high out-degree at the start (sources)
to the right

Use **proxy icons** to represent links to extracted nodes.





Users can **add nodes back to the main graph** or **extract more nodes**



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TensorFlow Graph Visualizer

Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow

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Introduction

Explore a Convolutional Network

Transformation Strategies

Usage Pattern & Feedback

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Feedback Sources

1) Structured questionnaire for internal users at Google

2) Mailing list conversations

3) Public feedback from online articles

Usage Pattern: **Inspecting New Models**

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"Understand what my code actually produced.
We had layers of functions and configs…
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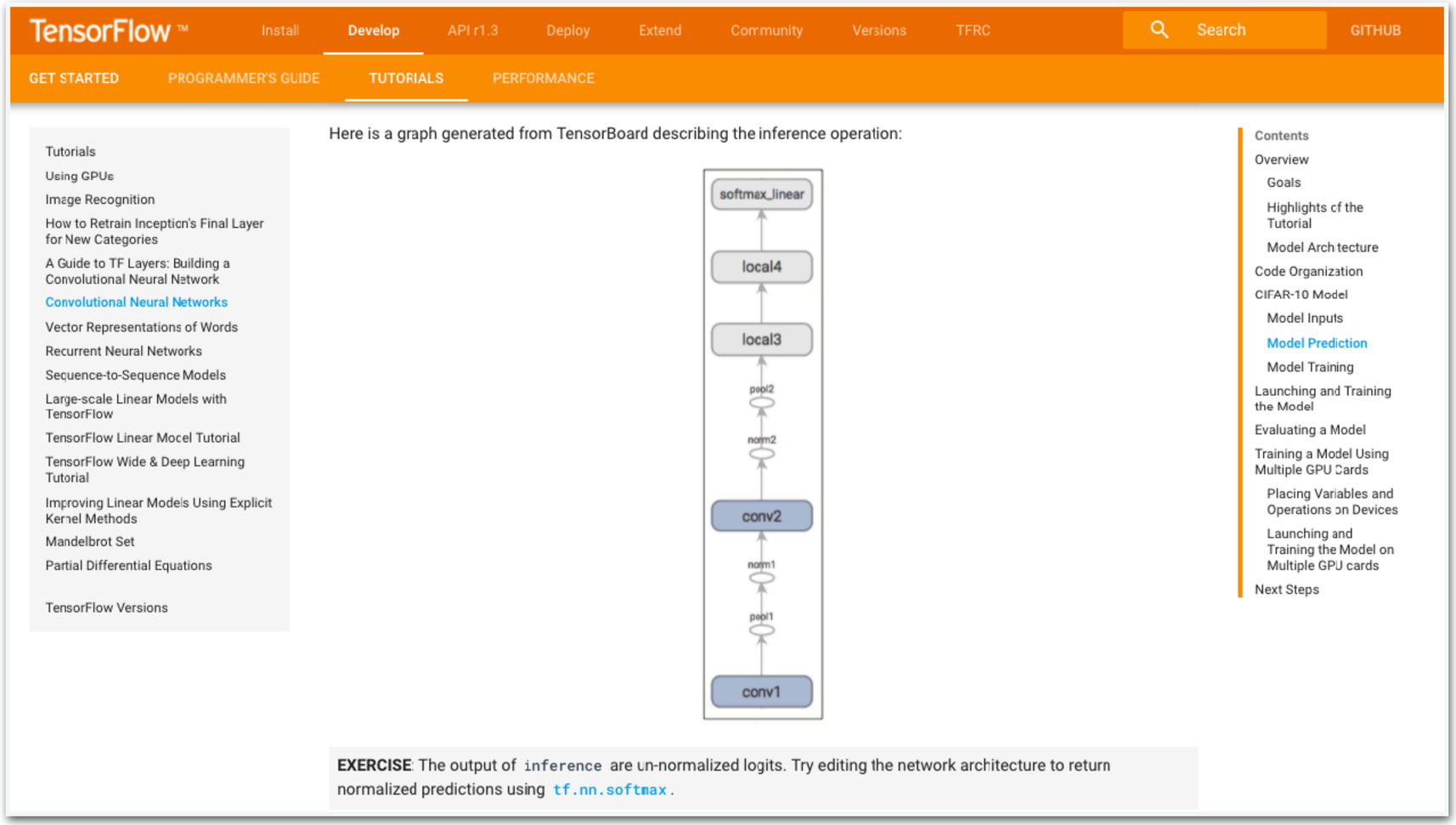
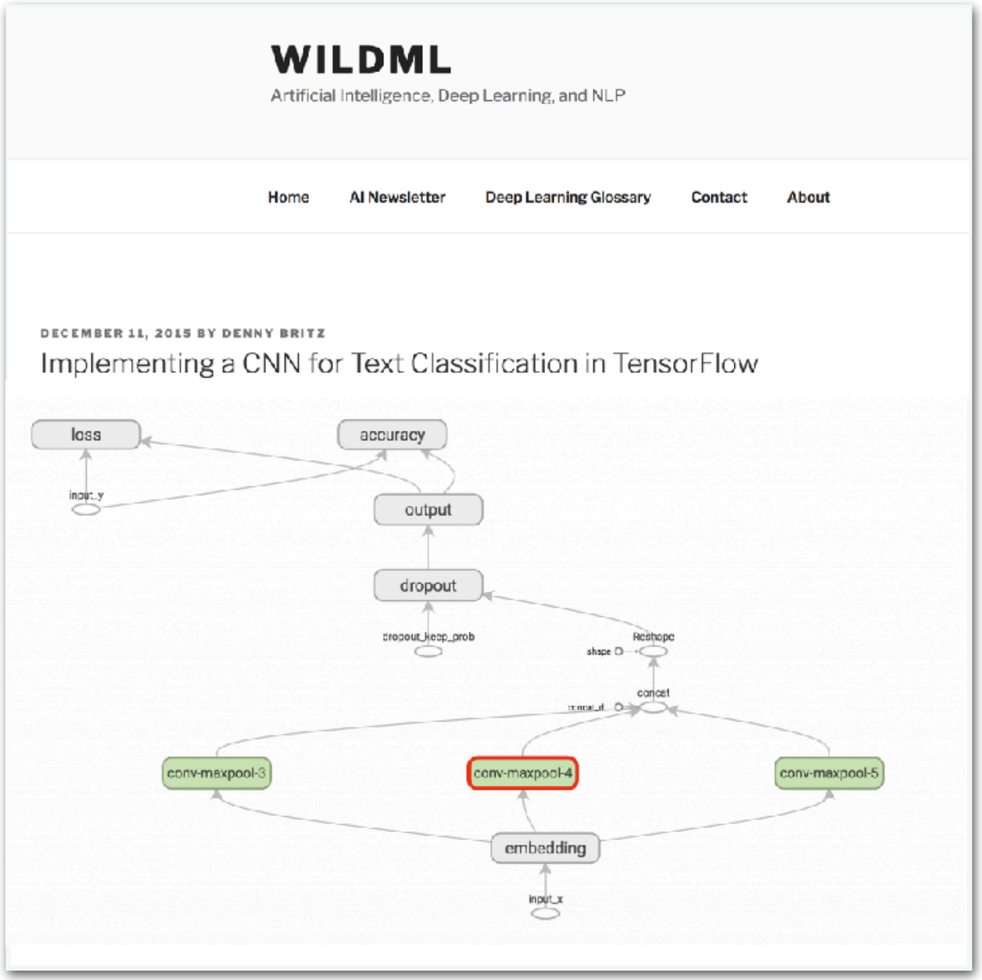
"Find the name of a tensor so that I could do further exploration
(like seeing the evolution of a particular input)"

Usage Pattern: **Using Screenshot to Explain Models**

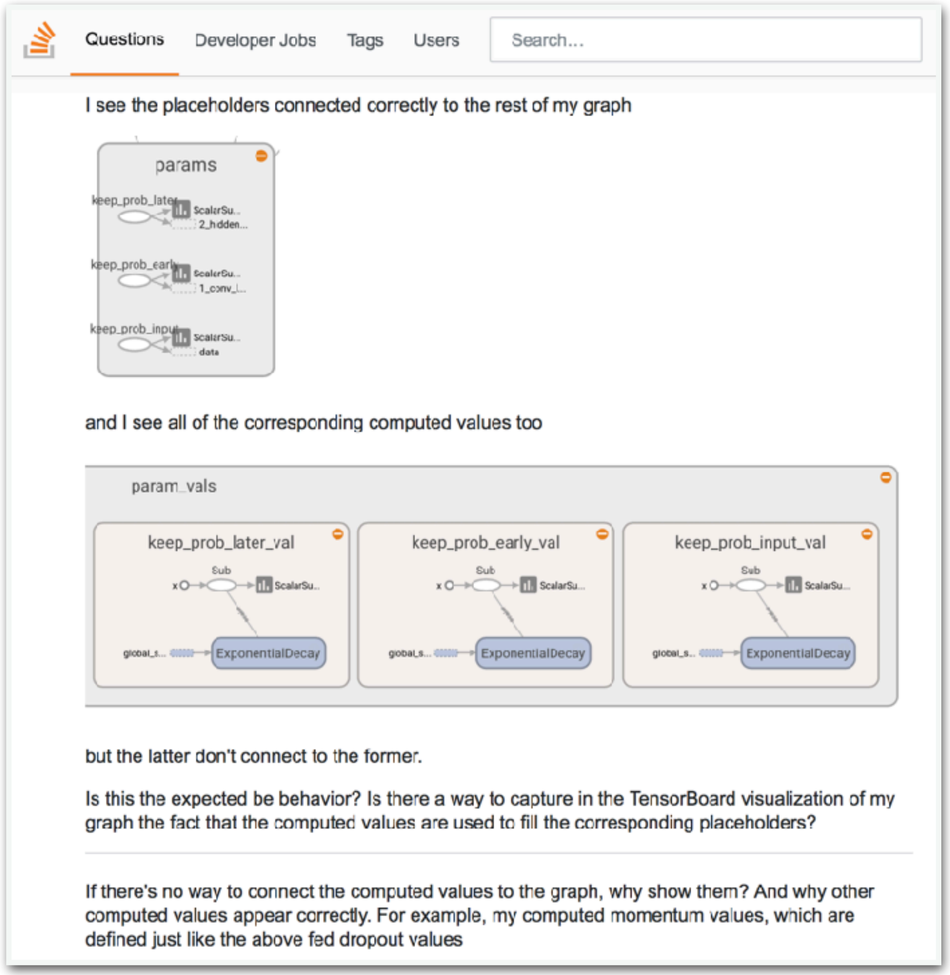


TensorFlow's Official Tutorials

Usage Pattern: **Using Screenshot to Explain Models**



3rd Party Articles



StackOverFlow Questions

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Many users iteratively rename until the visualization match their mental model, especially when sharing with others.

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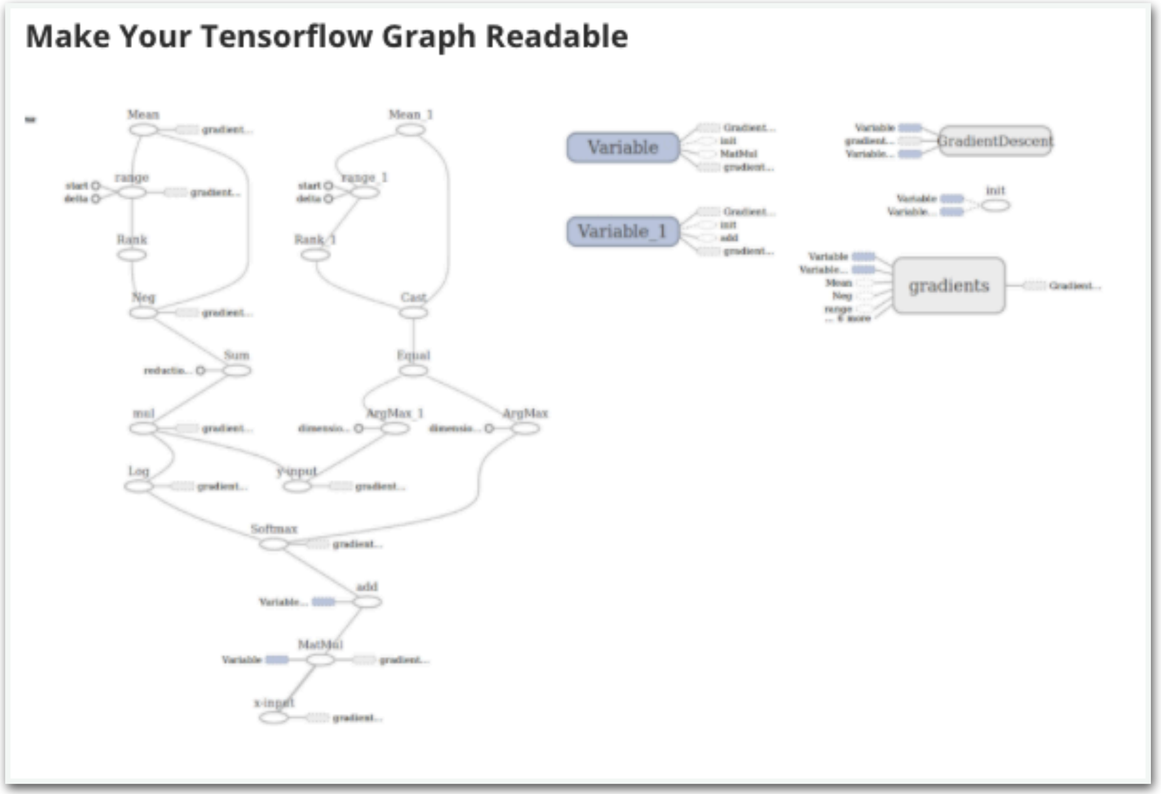

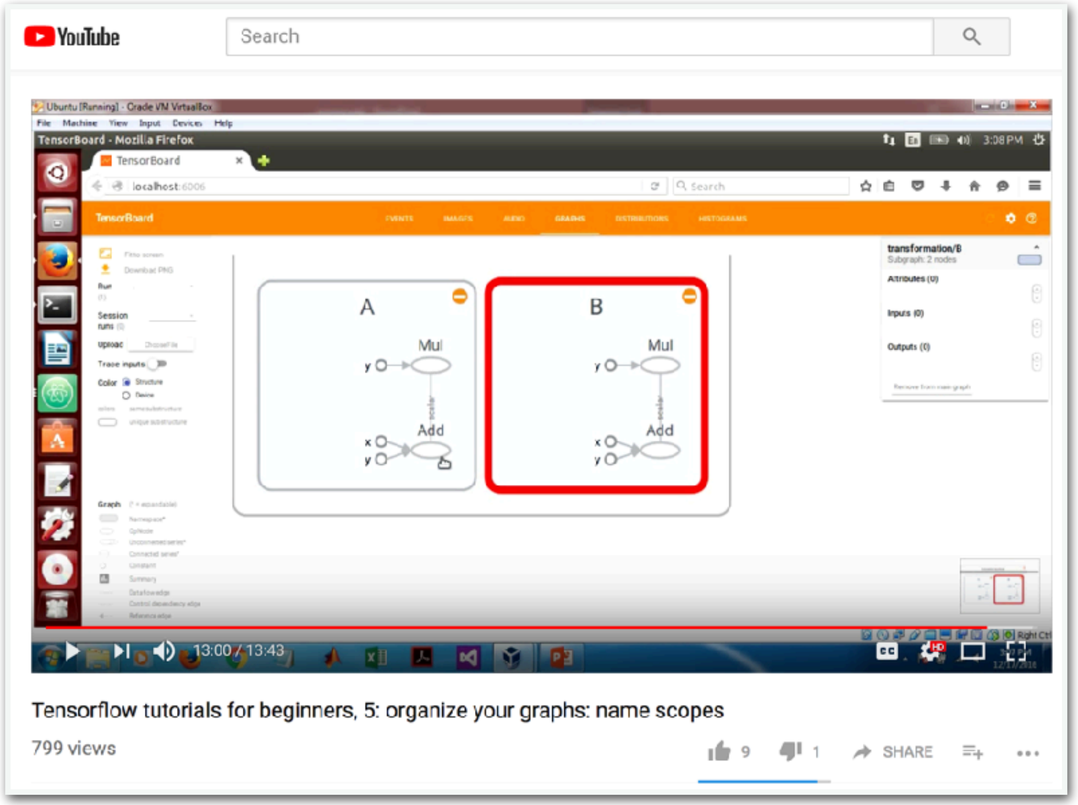

Public Feedback:

Model Visualization is a key feature of TensorFlow

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"One of the main lacking areas of almost all open source Machine Learning packages, was the ability to visualize model and follow the computation pipeline" – Quora

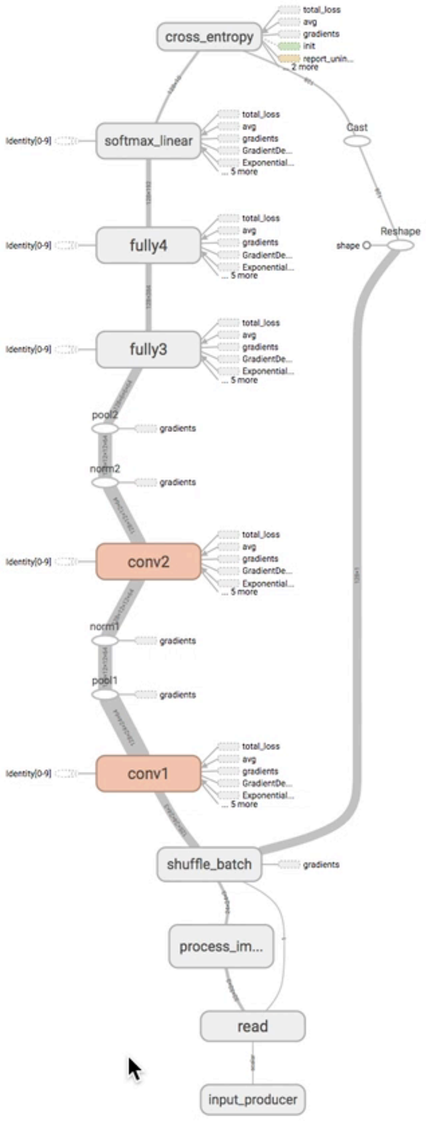
"We believe visualization is really fundamental to the creative process and our ability to develop better models. So, visualization tools like TensorBoard are a great step in the right direction." – Indico

TensorBoard SCALARS IMAGES AUDIO GRAPHS DISTRIBUTIONS HISTOGRAMS EMBEDDINGS

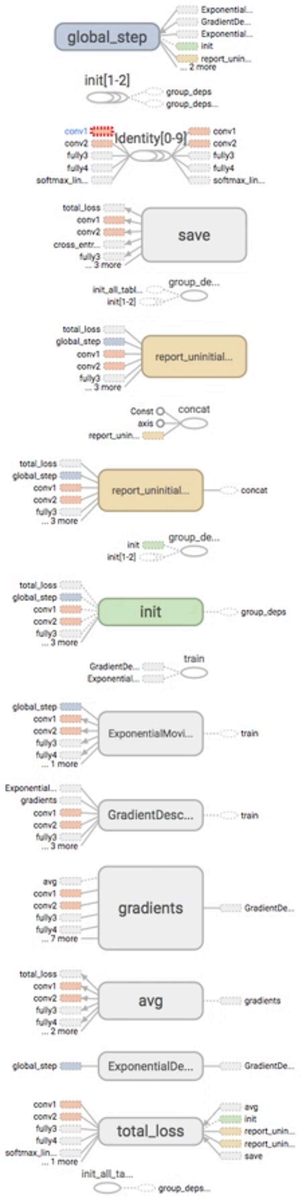
Fit to screen
Download PNG
Run (2) run1
Session runs (0)
Upload Choose File
Trace inputs
Color Structure
Device
colors same substructure
unique substructure

Graph (* = expandable)
Namespace*
OpNode
Constant
Summary
Dataflow edge
Control dependency edge
Reference edge

Main Graph



Auxiliary Nodes



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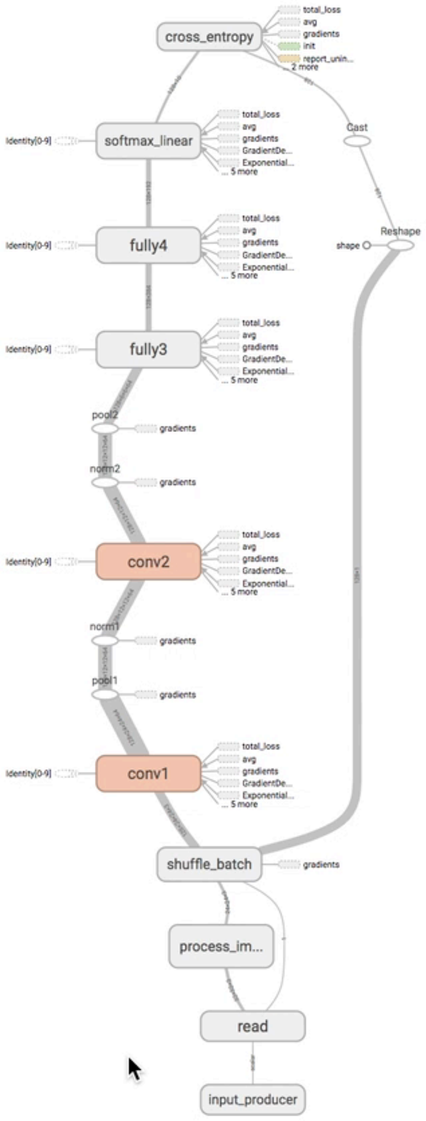

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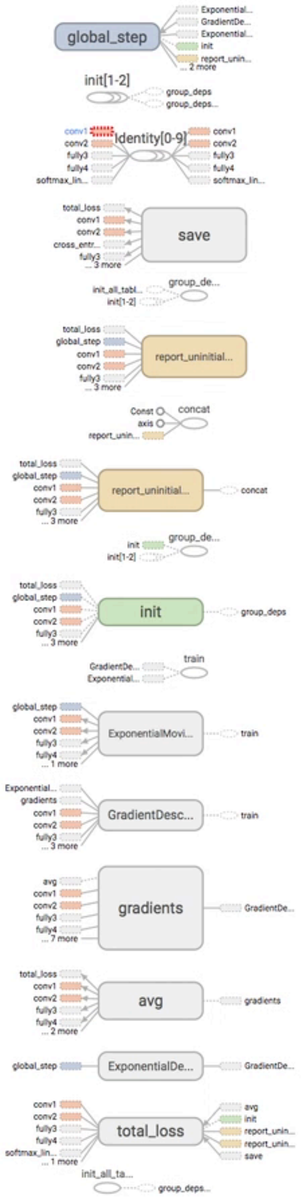
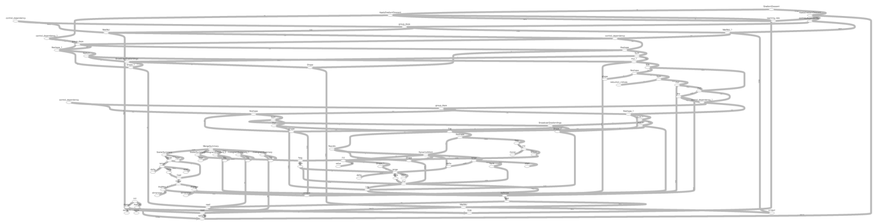
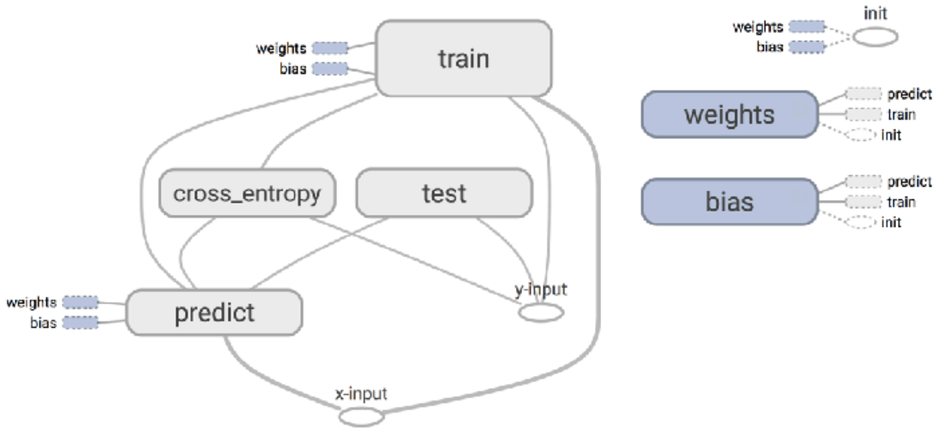




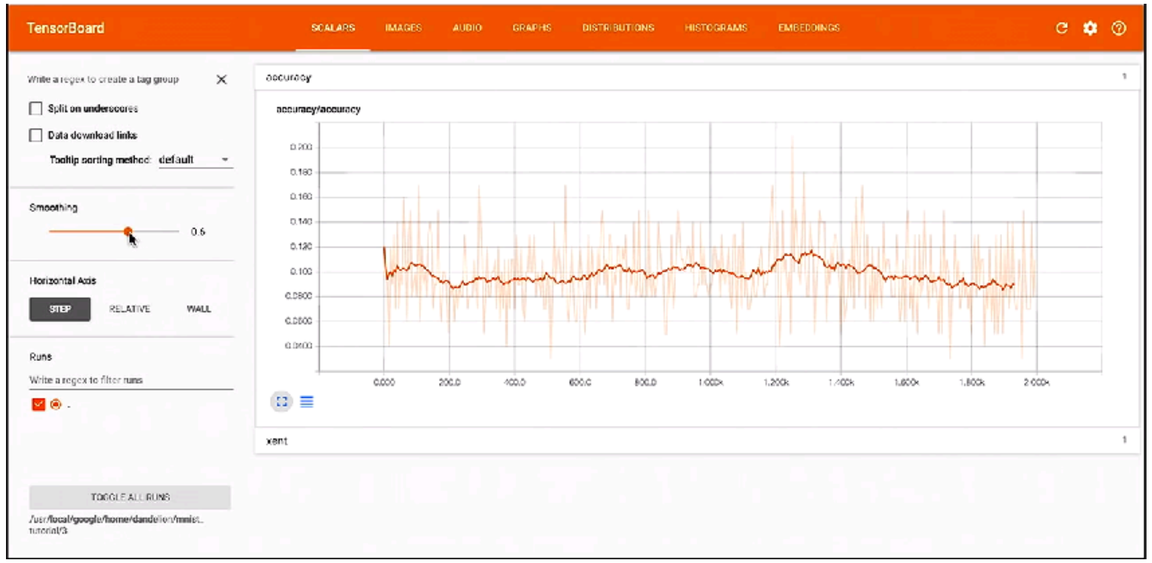
Low-level
Dataflow Graph

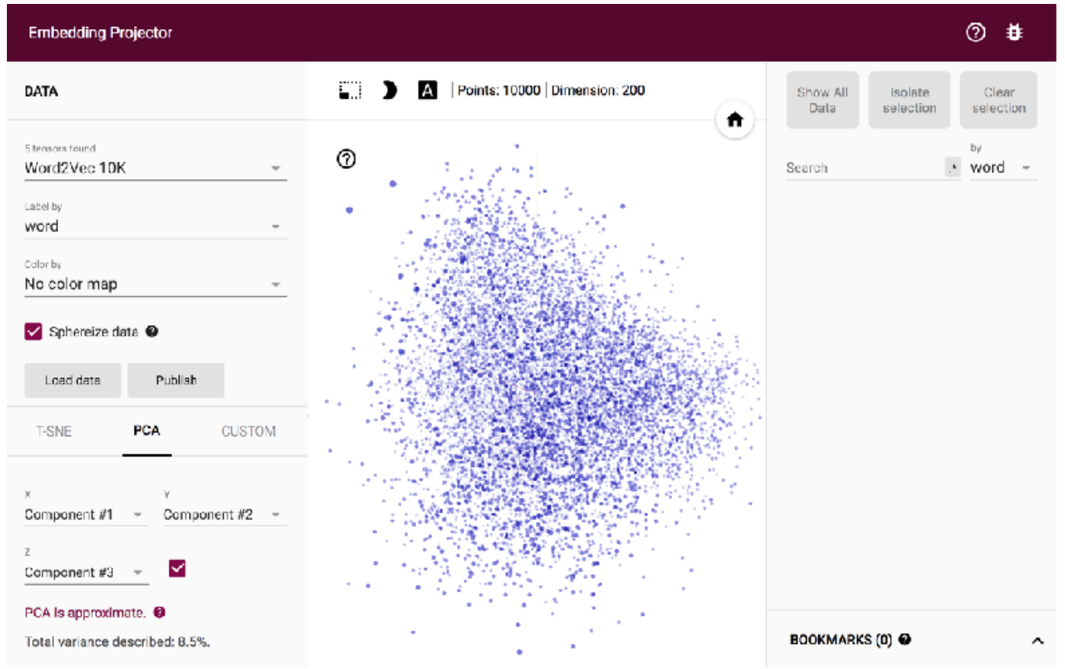
Build a
Clustered Graph
&
Extract Less
Important Nodes

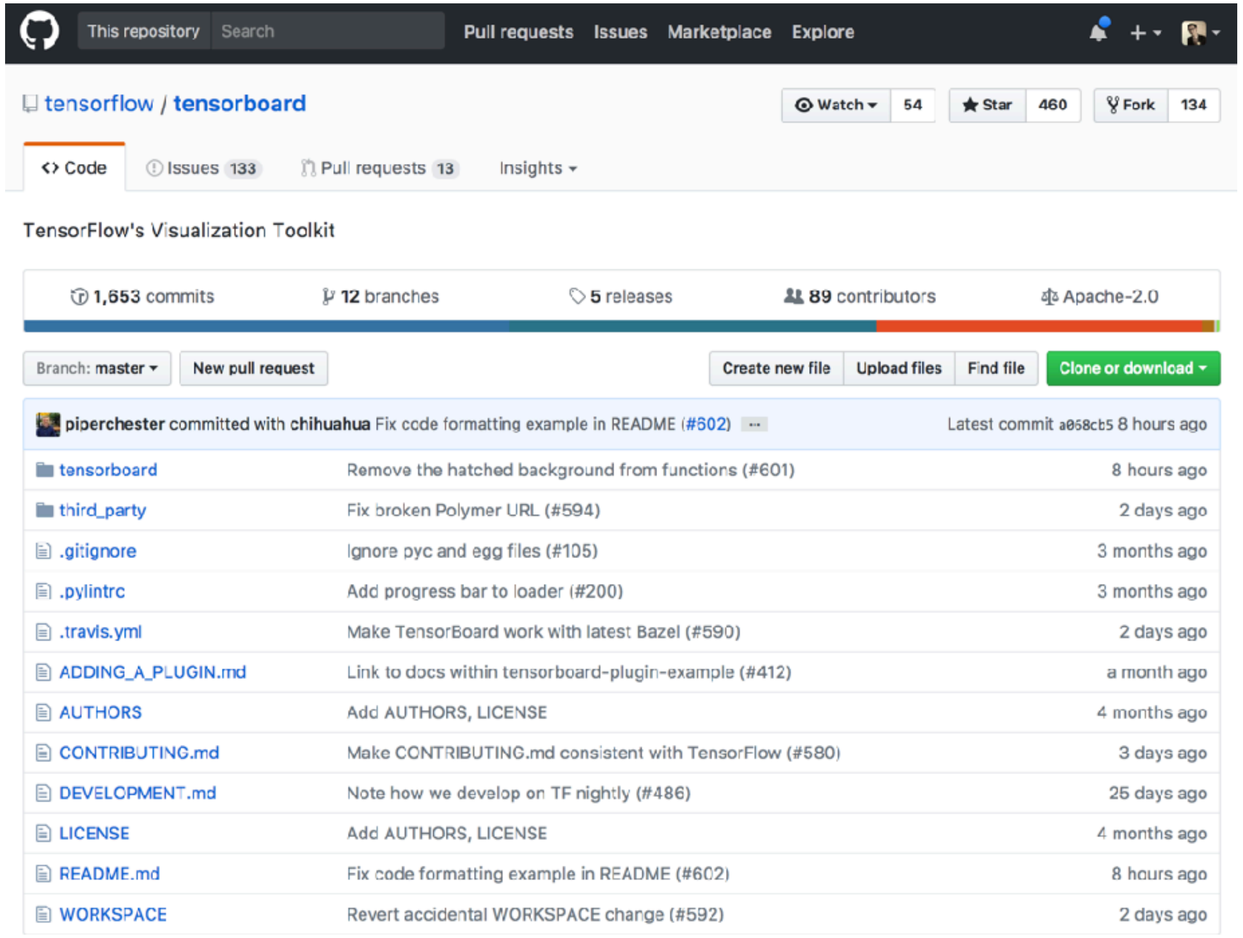


Interactive
Diagram

Visualization can play many important roles for machine learning







https://github.com/tensorflow/tensorboard

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TensorFlow's Visualization Toolkit

1,653 commits 12 branches 5 releases 89 contributors Apache-2.0

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piperchester committed with chihuahua Fix code formatting example in README (#502) ... Latest commit a058cb5 8 hours ago

tensorboard	Remove the hatched background from functions (#601)	8 hours ago
third_party	Fix broken Polymer URL (#594)	2 days ago
.gitignore	Ignore pyc and egg files (#105)	3 months ago
.pylintrc	Add progress bar to loader (#200)	3 months ago
.travis.yml	Make TensorBoard work with latest Bazel (#590)	2 days ago
ADDING_A_PLUGIN.md	Link to docs within tensorboard-plugin-example (#412)	a month ago
AUTHORS	Add AUTHORS, LICENSE	4 months ago
CONTRIBUTING.md	Make CONTRIBUTING.md consistent with TensorFlow (#580)	3 days ago
DEVELOPMENT.md	Note how we develop on TF nightly (#486)	25 days ago
LICENSE	Add AUTHORS, LICENSE	4 months ago
README.md	Fix code formatting example in README (#602)	8 hours ago
WORKSPACE	Revert accidental WORKSPACE change (#592)	2 days ago

https://github.com/tensorflow/tensorboard

Build your own Machine Learning Visualizations with the new TensorBoard API

Monday, September 11, 2017

Posted by Chi Zeng and Justine Tunney, Software Engineers, Google Brain Team

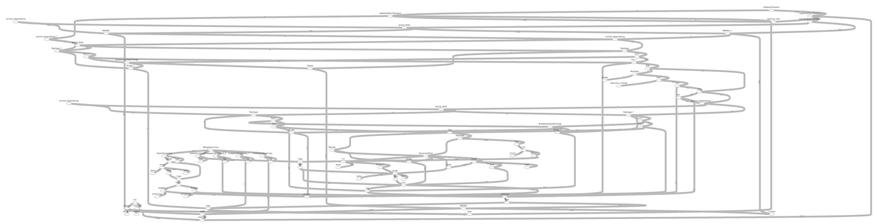
When we open-sourced TensorFlow in 2015, it included TensorBoard, a suite of visualizations for inspecting and understanding your TensorFlow models and runs. Tensorboard included a small, predetermined set of visualizations that are generic and applicable to nearly all deep learning applications such as observing how loss changes over time or exploring clusters in high-dimensional spaces. However, in the absence of reusable APIs, adding new visualizations to TensorBoard was prohibitively difficult for anyone outside of the TensorFlow team, leaving out a long tail of potentially creative, beautiful and useful visualizations that could be built by the research community.

To allow the creation of new and useful visualizations, we announce the release of a consistent set of APIs that allows developers to add custom visualization plugins to TensorBoard. We hope that developers use this API to extend TensorBoard and ensure that it covers a wider variety of use cases.

We have updated the existing dashboards (tabs) in TensorBoard to use the new API, so they serve as examples for plugin creators. For the current listing of plugins included within TensorBoard, you can explore the tensorboard/plugins directory on GitHub. For instance, observe the new plugin that generates precision-recall curves:

Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow

Kanit “Ham” Wongsuphasawat, Daniel Smilkov, James Wexler, Jimbo Wilson,
Dandelion Mané, Doug Fritz, Dilip Krishnan, Fernanda B. Viégas, Martin Wattenberg



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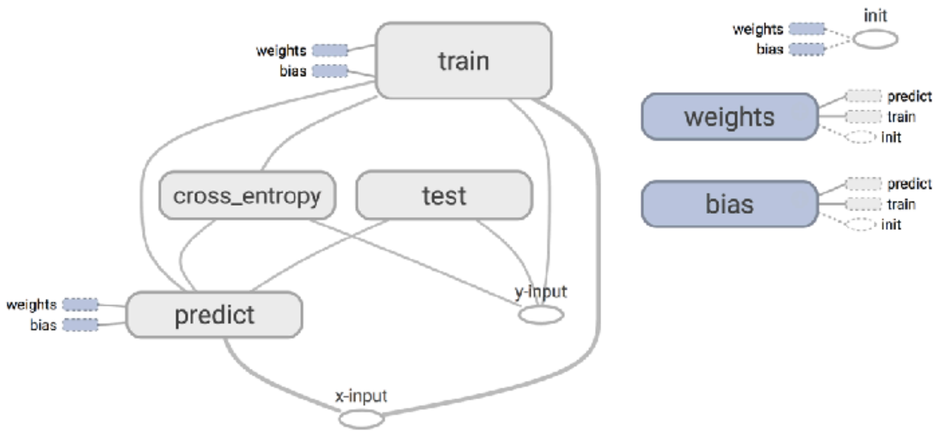

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